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HIGHER EDUCATION AND THE DEMAND FOR SCIENTIFIC MANPOWER IN THE UNITED STATES, OECD REVIEWS OF NATIONAL POLICIES FOR SCIENCE AND EDUCATION.

BY- COCKCROFT, JOHN AND OTHERS
ORGANISATION FOR ECONOMIC COOPERATION AND DEV.

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PROBLEMS OF HIGHER EDUCATION IN THE UNITED STATES IN RELATION TO FUTURE DEMANDS FOR SCIENTIFIC AND TECHNICAL MANPOWER ARE CONSIDERED IN THIS 1963 REVIEW OF NATIONAL POLICIES CONDUCTED BY THE ORGANISATION FOR ECONOMIC COOPERATION AND DEVELOPMENT (OECD). A DESCRIPTION OF THE STRUCTURE OF THE UNITED STATES HIGHER EDUCATION SYSTEM EMPHASIZES (1) RESOURCES FOR EXPANSION, (2) THE SUPPLY OF UNDERGRADUATE AND GRADUATE STUDENTS AND TEACHERS, (3) THE QUALITY OF TEACHING, AND (4) FEDERAL SUPPORT. THE REMAINDER OF THE DOCUMENT IS CONCERNED WITH THE PROCEEDINGS OF THE MEETING BETWEEN THE ORGANISATION FOR ECONOMIC COOPERATION AND DEVELOPMENT COMMITTEE AND A DELEGATION FROM THE UNITED STATES. CONSIDERED IN THIS DISCUSSION ARE (1) ECONOMIC AND SOCIAL FACTORS RESPONSIBLE FOR SCIENTIFIC AND TECHNICAL EDUCATION, (2) THE SCIENTIFIC AND TECHNICAL MANPOWER SHORTAGE, (3) THE ROLE OF THE FEDERAL GOVERNMENT IN THE FINANCING OF HIGHER EDUCATION, AND (4) THE EFFECT OF FEDERAL SUPPORT OF SCIENCE ON HIGHER EDUCATION. THIS DOCUMENT IS ALSO AVAILABLE FROM THE MCGRAW-HILL BOOK COMPANY, OECD UNIT, TMIS ANNEX, 351 WEST 41ST STREET, NEW YORK 36, NEW YORK, FOR $1.00. (AG)

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REVIEWS OF NATIONAL POLICIES
FOR SCIENCE AND EDUCATION

HIGHER EDUCATION AND THE DEMAND FOR SCIENTIFIC MANPOWER IN THE UNITED STATES

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REVIEWS OF NATIONAL POLICIES FOR SCIENCE AND EDUCATION

HIGHER EDUCATION AND THE DEMAND FOR SCIENTIFIC MANPOWER IN THE UNITED STATES

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

PARIS NOVEMBER 1963

The Organisation for Economic Co-operation and Development was set up under a Convention signed in Paris on 14th December 1960 by the Member countries of the Organisation for European Economic Co-operation and by Canada and the United States. This convention provides that the O.E.C.D. shall promote policies designed :

— to achieve the highest sustainable economic growth and employment and a rising standard of living in Member countries, while maintaining financial stability, and thus to contribute to the development of the world economy ;
— to contribute to sound economic expansion in Member as well as non-member countries in the process of economic development ;
— to contribute to the expansion of world trade on a multilateral, non-discriminatory basis in accordance with international obligations.

The legal personality possessed by the Organisation for European Economic Co-operation continues in the O.E.C.D., which came into being on 30th September 1961.

The Members of O.E.C.D. are Austria, Belgium, Canada, Denmark, France, the Federal Republic of Germany, Greece, Iceland, Ireland, Italy, Luxemburg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States.

The Directorate for Scientific Affairs, which is responsible for the publication of the present report, has been established within O.E.C.D. to take charge of the activities of the Organisation relating to scientific research and to the expansion and rational utilisation of the scientific and technical personnel available so as to meet the needs arising from economic growth.

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PREFATORY NOTE

Reviews of National Policies for Science and Education are conducted by the O.E.C.D. to assist Member countries in reassessing their programmes in two areas of public policy that have an increasingly important bearing on economic growth and social well-being: the development of human resources and the stimulation of scientific and technological progress. Each review can, of course, deal only with some specific aspects of these broad topics but it is hoped that the series will cumulatively make a significant contribution to the evolution of national policies affecting science and education.

The individual reviews are intended to serve the interests not only of the country under review but also of other Member countries and, indeed, of non-member countries as well. The role of science and education in national development, the way in which science and education can — or should — be linked to economic policy and social demand, the competing needs of research and teaching and similar questions are matters that concern people everywhere. They present problems which every national government must face. There is, in these matters, much to be gained from an exchange of views and from an examination of the experiences — the successes and the mistakes — of others.

The procedure for the reviews is for a small team of experts to visit the country under review for extensive discussions with government officials, members of the academic and scientific communities, representatives of industry and other appropriate individuals and institutions. The observations and conclusions of the examiners are included in a report which becomes the basis for a 'confrontation' meeting at the O.E.C.D. headquarters in Paris in which the examining team, a special delegation from the country under review and delegates from each of the other Member countries participate. The examiners' report is designed to raise questions, rather than to answer them, and the 'confrontation' meeting, therefore, takes the form not of a cross-examination of a particular delegation but of a round-table discussion, for the mutual benefit of all the participants, of a particular country's problems and policies.

The present review of the United States is primarily concerned with problems of higher education in relation to future demand for scientific and technological manpower. The discussion at the confrontation meeting dealt at some length with the role of the Federal Government in the financing of higher education and with the effects on the universities of a high level of support for scientific research. Some of the participants also expressed considerable interest in American experience with virtually universal secondary education and the apparent trend toward almost universal higher education in the United States.

The examiners and the O.E.C.D. Secretariat are most grateful for the unstinting help they received in the preparation of this review from American government officials, especially in the National Science Foundation and the Office of Education, and from many busy people in the universities and other institutions. Special thanks are due to those who spent much time in verifying the factual statements both in the examiners' report and in the summary of the confrontation discussion. The opinions expressed in Part I of this brochure are, of course, those of the examiners.

PART I

REPORT BY THE EXAMINERS

REPORT BY THE EXAMINERS

Sir John COCKCROFT, Dr. A. H. HALSEY, Professor Ingvar SVENNILSON

Rapporteur : Dr. A. H. Halsey

1. INTRODUCTION

1. As O.E.C.D. examiners we have been asked a question about the future of science and technology in America which can be phrased in terms of simple economic supply and demand. What increase in demand for scientific and technological manpower will be generated in the nineteen sixties and seventies and how will it be met ? The question may be answered in the same terms. There will be an increased demand, especially because of the activities of federal agencies, and there will be a responding, more or less inelastic supply. There will be price-determining mechanisms, short and long run, which will equate supply to demand. Under free market conditions there could, by definition, be no shortage. But we should not have been invited nor should we have felt justified in crossing the Atlantic to give such an answer, no matter how elaborately formulated. There is much worry in high places that shortages will be present in 1970 unless immediate and drastic measures are taken to increase supply — shortages which will impair the economic and scientific efficiency of the United States and endanger her political and military role in the world.

2. These anxieties are partly a recognition of the irrelevance of the pure market model. They stress implicitly the special conditions of demand created by the massive involvement of the federal government in the generation of demand for more scientists (and, no less importantly, for more science). They also imply recognition of the special conditions of supply of high scientific and technological manpower. Institutions of higher education are not simply units of the economy but complex organizations with multiple functions for society, policy and culture as well as for the economy — so that manpower supply is as much a by-product as a product of the educational system.

3. Thus, in any consideration of American universities and colleges as agencies for the supply of scientific manpower, we shall unavoidably be led on to deal with other functions of higher learning such as the preservation of balance in intellectual life, the autonomy of universities as free scholarly corporations, the balance of responsibility towards the

claims of research and teaching, the provision of equal educational opportunities and so on. At the same time it has to be recognized that not all scientific and technological manpower is produced in the academic mould of the baccalaureate or higher degree. Indeed about a quarter of America's engineers come to their professions by some other avenue. And finally analysis is further complicated by the fact that much of the academic product of scientists and engineers is either consumed by its producers or, for one reason or another, channelled into an administrative or other profession not directly related to the content of the academic qualification.

4. Quite apart from the difficulties that attend a conception of universities and colleges[1], in the language of the market there are serious problems of measurement involved in long-run analysis of manpower demand and supply. Projections to 1970 and beyond must rest on assumptions which, though plausible, are unproven.

5. The vast scale of demand is, of course, generated in large measure by the continuance of the 'cold war'. The competitive accumulation of military strength and scientific achievement has to be seen as a distortion of the energies of the American, as of other leading atomic nations. If it were to end, the shortage of high scientific manpower would end with it.

6. The quantity of demand is in any case difficult to establish : it has even been put to us that there is no serious overall problem of shortage but simply one of artificially inflated demand because of stockpiling and misallocation of scientists and engineers by companies in the market for government contracts. It is even more difficult to establish the likely quality of demand, i.e. the types of scientific and engineering skill that will be required by the technology of the 1970's. This makes it difficult to know what ought to be the balance in an expansion programme as between graduate and undergraduate programmes in science and engineering, and between university or four-year programmes and the engineer-programmes of junior colleges and technical institutes designed to train the semi-professional engineer.

7. Supposing we could solve all these difficulties — which we can't — it is doubtful whether the scope and method of our inquiry would be satisfactory as means to that end. We are painfully conscious of our shortcomings as fleeting visitors to a strange land. Three of us spent five days in the offices of Washington politicians and administrators ; two of us spent a few days together in the universities and colleges of California, and one of us undertook a three-week tour of some 20 institutions and organizations connected with American higher education. Our only assets were the impressionability of naiveté, some acquaintance with the equivalent problem in Europe, and a conviction of the relevance of American experience for other O.E.C.D. countries.

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1. Colleges : institutions sometimes forming part of universities, offering 4-year post-secondary training in one or more general fields (arts and sciences, engineering, agriculture, forestry, home economics, commerce, teacher-training and granting the degree of Bachelor of Arts or Bachelor of Science. *World Survey of Education*, Vol. II, 1958 UNESCO.

8. By way of introduction to the sections which follow we should like to record two impressions from our visits. One is the enormous cheerfulness of Americans in the face of large numbers. Ambitious expansion programmes, gigantic capital needs, huge recruitment requirements of faculty and students — all are contemplated with an optimistic, almost casual, expectation of success that cannot but impress the visiting European. It is hard to find a college president or a Washington official who entertains serious doubts about the capacity of his countrymen to find the money to build, the faculty to teach or the students to learn in American universities. There are no lurking theories of limited 'pools of ability' or of an educational 'wages fund' of the kinds that are never far from the surface of equivalent European discussion. We find this delightfully refreshing.

9. The other is the widespread instinct for autonomy and independence. It takes many forms. One is a readiness to think in terms of the model of the private competitive business enterprise. The optimism to which we have referred seldom expresses itself in terms other than the seeking of solutions for itself by the particular college or university concerned. Even the Cassandras, like Sidney Tickton, characteristically insist on the maximum assimilation of universities and colleges to the profit and loss concepts of the business enterprise. In so far as all this manifests a spirit of local energy for educational progress it is entirely laudable. But the other side of the picture is an alarming mistrust of co-operative, public and especially federal planning without which, if our assessment is correct, higher education will not be able to meet the demands of the common good in 1970. Perhaps the most serious manifestation of this American ambivalence towards Federal Government is the failure of Congress to pass some of the legislation which is urgently needed now if the educational output of 1970 is to be adequate. The progress of higher education is threatened by these circumstances.

10. Nevertheless we came away more excited by the promise than depressed by the difficulties. Indeed we are convinced that our enquiry has more to offer to the European than to the American members of O.E.C.D. — a pre-view of things to come in a successful future. The United States is neither without problems nor without its critics. But any analysis of the service made by its educational system to its economy must begin by recognizing the scale of American achievement, with its traditional roots in the pragmatism of the land-grant college movement and its present fruit in an unrelenting drive towards maximizing the educational potential of individuals and continuously improving the material strength of the nation.

2. SCIENTIFIC MANPOWER : SUPPLY AND DEMAND

11. The problem of the future balance between supply and demand may be approached in different ways. One way is to estimate the demand for various kinds of qualified persons in a given period and to set this against projections of supply from academic and other sources. A recent

study at NSF[1] adopted this method and showed that an annual short-fall of some 14,000 engineers will obtain in the nineteen sixties. In the case of scientists a rough balance was anticipated.

12. The study was prepared by the U.S. Bureau of Labor Statistics. The main elements in it were a forecast of total employment in various fields of the US economy and a projection of the ratio of scientists and engineers to total employment. This ratio (the "density") is assumed to rise according to past trends with some adjustments made on the basis of other information. In the manufacturing industry, the density of scientists and engineers, for example, is projected to rise from 3.5 per cent in 1959 to 5.3 in 1970. Taking into account employment in the total civilian economy, including colleges and universities, the following main results were reached : to meet the projected demand for engineers during the sixties, 72,000 new engineering graduates, on average, will have to be produced annually. On the other hand, if, as projected, the degrees awarded in all fields rise by 80 per cent during the decade, and if the proportion that *engineering graduates* represent of all graduates remains constant, then the supply of graduates in engineering, as an annual average for the sixties, will reach 58,000. It thus appears that to meet the projected demand, *the number of engineering graduates would need to increase at a faster rate than college graduations in general.*

13. A corresponding estimate for science graduates does not indicate that any deficit would arise in the 1960 decade. However, evidence of increasing demand for science graduates *with advanced degrees,* indicates that there may be a considerable gap between the supply of and the demand for such highly qualified personnel.

14. Even if this technique of forecasting the future balance of supply against demand is accepted as the best possible method, there are evidently a number of important uncertainties as regards various assumptions. Some of these uncertainties may be mentioned. First, it has been estimated that between 1950 and 1959, 23 per cent of all new entrants into the engineering profession came into the field without an engineering degree. In the forecasts of demand it has been assumed that this ratio will remain the same in the future. Would it not be reasonable to expect that this ratio will fall, as a larger proportion of the new generations goes to college and university ? If this should be the case, the demand for college and university engineers would rise faster than anticipated. Second, a critical point is the ratio of college and university engineers to technicians with a lower level of education. This ratio seems to be considerably higher in the United States than in Europe (though we do not know how far the differences are terminological rather than real). If this ratio were to fall, the demand for engineers might have been over-estimated. Third, the most critical point is, however, found on the supply side. The balance between supply and demand has been arrived at on the assumption that the number of engineering graduates will rise by 80 per cent in a decade, or in the same proportion as the projected number of graduates in all fields. Actually, the share of

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1. NSF 61-65, *Long Range Demand for Scientific and Technical Personnel. A Methodological Study.*
See also NSF 61-27, *Investing in Scientific Progress.*

engineering in total enrolment has tended to fall in recent years, with some very recent evidence of a reversal in the trend against engineering enrolment.

15. In the face of these uncertainties, another approach to the problem may be chosen. It may be claimed that demand for people with higher education should not be derived from a predetermined estimate of the development of the economy. On the contrary, it is the *supply* of such personnel that, in combination with other factors, determines the pace of economic growth. Educational targets, thus, should be regarded as one facet of general growth targets. This approach to the problem leads to the simple conclusion that *a maximum effort* should be made to expand education in the field of science and engineering. This policy, must, however, be modified by two considerations. *First*, the distribution of students among various fields must not fall out of line with trends in the distribution of demand ; expansion of science and engineering education must not be allowed to reduce too heavily the number of students in other fields. In this respect, forecasts of manpower budgets of the type referred to above may provide some guidance. In any case, it may be presumed that the share of science and engineering in the American colleges and universities can with advantage be increased in the future.

16. *Second*, the expansion of science and engineering education must not be so fast as to retain in the educational system too large a share of the annual output of graduates in this field, and especially of the small output at the doctoral level, thus reducing the output in other fields. This aspect of the policy problem may in the final analysis emerge as the decisive bottle-neck for the expansion of science and engineering education. In our discussions at the National Science Foundation we were informed that studies of this problem were now under way.

17. According to these considerations, the crucial issues in solving the supply/demand problem seem to be *to increase the proportion of undergraduate students who proceed to graduate and doctoral studies in science and engineering* (this proportion is now quite low) *to strike a balance between doctoral graduates who are retained in teaching and those who are "released" for employment outside colleges and universities*. The latter problem may be regarded as one of strategy over time. A big feed-back into the educational system of doctors in science and engineering in the next five to ten years would starve other fields in the same period, but would swell output from the teaching system in later years. The strategy view must, therefore, be extended over at least two decades. Space and other development programmes may have to be restricted in such a way that the approach to affluence as regards trained science and engineering talent is not postponed indefinitely.

The Utilization of Scientific Manpower

18. The market for scientific manpower has the special characteristic of being affected on both its supply and demand sides by the operations of the Federal government to a degree which overshadows all other influences. It has been put to us that the federal government directly or indirectly through its grants and contracts to industry and the universities

for research and development, is funding the work of perhaps as many as three quarters of U.S. scientists and development and design engineers. Given these circumstances it may be worthwhile to ask whether the actual utilization of scientific manpower is in accordance with the national interest.

19. We cannot hope to answer this question, for one of the most obvious features of the situation is an absence of firm information about the efficiency of utilization. We can however record some of the difficulties that have been mentioned to us.

20. First, it must be noted that the influence of the federal government on the demand side is not only important already but is increasing with rising expenditure on national defence and security. For example, the National Aeronautics and Space Administration (N.A.S.A.) is expected to absorb 2,000 engineers per annum.

21. Second, federal demand is not simply to be measured by direct employment plus grants and contracts to universities. The government also foots the bill for much of the manpower engaged in private industry, especially in the industries related to defence, such as electronics and aircraft production, where some companies sell as much as 90 per cent of their product to the government and may therefore be thought of as quasi-public institutions. Moreover, it is apparently the case that the funding of scientific work in industry by the government is not only by direct contract but also by the underwriting of an agreed proportion of a company's general research budget. In short, the Federal government is the largest user of scientific manpower and largely determines the size and nature of research and development in both academic and industrial institutions.

22. It follows that the non-academic scientific community is a growing one. Doubts are expressed as to whether it is efficiently utilized in the competitive preparation of tenders for government contracts. Similar doubts are to be heard in the academic world about the time spent preparing proposals in university departments and the time spent sifting and judging them in Washington and on planes between Washington and the campus. Some companies are thought to hoard Ph.Ds for contract purposes and even for prestige. One wonders if something similar may happen in some university departments. Hoarding and under-utilization by companies is made easy by the "cost-plus-profit" arrangement in some government contracts.

23. What is even more clear is that federal financing of science exercises a profund effect on the intellectual life of the universities in ways which cannot be excluded from any consideration of the national interest. Many critics of the contemporary academic scene see the American university as increasingly pulled out of shape by neglect of the humanities, and by the pursuit of science for political, military and industrial purposes. Orlans' recent study[1] reports the pattern of answers to the following question asked of university faculty.

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1. H. Orlans, *The Effect of Federal Programs on Higher Education*. Brookings Institution, 1962.

24. "Do you regard the present concentration of federal funds in the natural sciences and relative neglect of the humanities as:

a) in the present national interest?
b) in the long-run national interest?
c) in the interest of your institution?"

25. It turned out that some 70 per cent of the scientists, and more than 90 per cent of the social scientists and humanists believe that the present pattern is neither in the long-run national interest nor in the best interests of their institution.

26. What lies behind these opinions is a situation where the balance between science and the humanities in respect of research effort, faculty quality, prestige and income and student quality is felt to be distorted by the concentration of federal funds on science and scientific research.

27. Even if this larger perspective is ignored there remains the problem of the use of scientists as between research and teaching. The non-academic community tends to be lost to teaching. But so too are many of the university scientists employed on research contracts, and the career pattern which involves staying on past the Ph.D. for two or three years as a research associate without academic tenure is increasingly common[1] and of obvious attractiveness to ambitious young scientists.

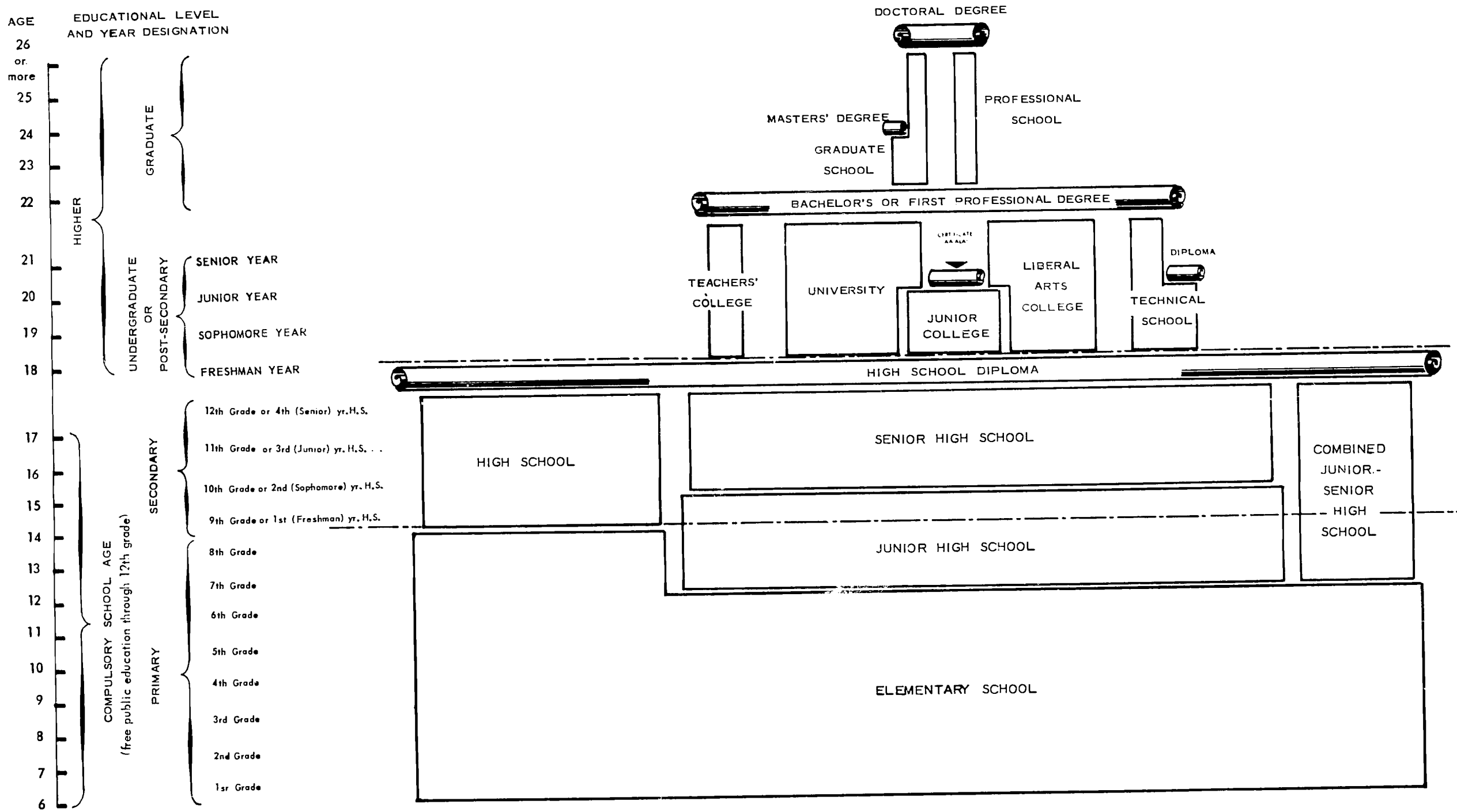
28. The loss of research men to the teaching function is not necessary as the recent Harvard experiment, involving such men in undergraduate tutoring, has shown. Similar schemes involving both research associates in universities and research centres as well as the non-academic community of scientists and technologists could make a crucial contribution to the shortage of highly qualified teachers of science and at the same time improve the utilization pattern of scientific manpower.

3. STRUCTURE OF HIGHER EDUCATION IN THE UNITED STATES

29. In the historical development of higher education in the United States from the middle of the 19th century, nothing figures more prominently than the rise of science and technology. The shape of American higher education today in comparison with that of other O.E.C.D countries, is largely a response to social demand for new science and scientists and new technology and technologists. Only in the U.S.S.R. since 1917, has the development of an educational system been more completely dominated by the manpower requirements of advanced industrialism. Of course the Russian and American educational systems differ greatly both in their history and their present structure, but the differences are alternative methods towards the same resultant relation between higher education and the supply of high scientific and professional manpower. In Russia the result has been achieved through central political direction. In America the equivalent force has been *competition* between many autonomous "academic corporations" in the market for academic

1. For example, California Institute of Technology has 150 post-doctoral fellows.

Figure 1. SCHEMATIC OUTLINE OF U.S. EDUCATIONAL SYSTEM



they give considerable stress to graduate instruction, confer advanced degrees as well as bachelor's degrees in a variety of liberal arts, and have at least two professional schools that are not exclusively technological, they may appropriately be termed *universities*. The United States has 143 universities so defined. They are typically large institutions with a student body approaching 11,000 (only one university in the United Kingdom exceeds this average figure) and they cover 43 per cent of all students reading for degrees.

TABLE 1. UNITED STATES DEGREE-CREDIT INSTITUTIONS OF HIGHER EDUCATION 1960-61

TYPE	NUMBER	AVERAGE ENROLLMENT	PERCENTAGE OF TOTAL ENROLLMENT, FALL 1960
4-Year Institutions :			
Universities	143	10,845	43.0
Liberal Arts Colleges	764	1,345	28.5
Independently Organised Professional Schools :			
Teachers Colleges	198	1,814	10.0
Technological Schools	50	2,140	3.0
Theological, Religious	176	238	1.2
Schools of Art	45	337	0.4
Other Professional	75	730	1.5
Junior Colleges	524	866	12.6
Total	1,975	1,828	100
(N)			(3,610,007)

Source : U.S. Office of Education, *Opening (Fall) Enrollment in Higher Education 1960 : Analytic Report,* 1961.

33. Colleges may be divisions of universities or they may be autonomous. Normally the term refers to a distinctively American institution — the *liberal arts college* where the principal emphasis is placed on a programme of general undergraduate education. In 1960-61, 764 institutions met this definition. The liberal arts college is usually much smaller than the European university — the average student body is about 1300. Universities and liberal arts colleges between them cover nearly three quarters of the degree-seeking student body.

34. These two types of institution are sometimes linked, for example, by the 3-2 arrangement at M.I.T. through which an undergraduate spends three years in a liberal arts college followed by two years' engineering training at M.I.T. The remaining schools and colleges are described as follows : "The category of 'independently organised professional schools' consists of institutions which offer professional training but which are not affiliated with universities. There are five groupings within this category (a) *teachers colleges* — devoted primarily to teacher training ; (b) *technological school* — providing training predominantly in technical and physical science disciplines ; (c) *theological and religious schools* — in which the programme offerings are wholly or principally in theology,

religion or religious education; (d) *schools of art* — specialising in painting, sculpture, design, drama, music, dance, etc.; and (c) *other professional schools* — offering programmes directed to one or more fields of specialisation such as medicine, law, business, pharmacy, optometry, etc."

35. *Junior Colleges* are also a distinctively American institution. They offer at least 2 years but less than 4 years of work and do not grant a bachelor's degree. Those included in Table 1 offer degree-credit programmes creditable by transfer to 4-year institutions.

36. In Table 2, the colleges, universities and schools of the United States are tabulated according to a more elaborate classification of the type of programme offered and the "highest level of offering". *The Educational Directory 1961-62* of the U.S. Office of Education recognises 2,040 institutions of a post-secondary character. Of these, 219 are listed as offering doctoral degrees, 455 have masters' or second professional degrees as their highest offering, and 741 offer bachelors' and/or first professional degrees but no graduate work. This makes a total of 1,225 degree-granting institutions (more than fifty times the number in the U.K.).

37. There is a roughly equal division in American higher learning between publicly and privately controlled institutions. The distinction is not however a simple one. It turns most clearly on the form of control. In public institutions a Board of Trustees, or equivalent governing body, is elected by the people or appointed by a government agency or official. Public institutions are usually thought to rely on city, state and federal funds but they in fact receive private bequests and, as we shall see, the private institutions are increasingly dependent on public financial support.

38. As may be seen from Table 3, private institutions easily outnumber public ones; but, because most private institutions are small, the position is reversed in respect of enrolment for degree courses. In 1960, 59.2 per cent of the total enrolment was in public institutions, and behind this figure there is a strong trend towards the relative enlargement of the publicly controlled sector. From 1955 to 1960, gains of 42.5 and 24.9 per cent took place respectively in the degree-course enrolment figures of publicly and privately controlled institutions. The fastest rates of growth in this period were among the public junior colleges (48.0 per cent) and the slowest among the private 4-year institutions (24.4 per cent). The heaviest concentration of junior college enrolment is in the Far Western States.

39. The quality of American institutions of higher education varies enormously. Some three-quarters of the 1,225 degree-granting institutions included in Tables 2 and 3 were of sufficient quality to have secured full accreditation by the regional associations[1]. The remainder had met less rigorous criteria for listing in the U.S. Office of Education directory. The major organisation of education for high level professional manpower is constituted by the 219 institutions granting doctoral degrees. Among these, there are 39 institutions belonging to the Association of American Universities and which dominate the scene to the extent of granting over two-thirds of the doctoral degrees and constituting the main centres of

1. See above, note 1, to page 18.

TABLE 2. NUMBER OF INSTITUTIONS BY TYPE AND HIGHEST LEVEL OF QUALIFICATION OFFERED, UNITED STATES 1961-62.

TYPE OF PROGRAMME	OFFERING HIGHEST LEVEL OF: TOTAL	2, BUT LESS THAN 4 YRS. BEYOND 12TH GRADE	ONLY BACH-ELORS &/OR FIRST PROF. DEGREES	MASTERS' &/OR 2ND PROF. DEGREES	PH.D. OR EQUIV.	OTHERS
a) Terminal - Occupational	56	55	—	—	—	1
b) Liberal Arts & general	133	47	67	15	2	2
c) Liberal Arts & general & terminal occupational	313	290	21	1	—	1
d) Primarily teacher preparatory	116	30	36	47	2	1
e) Liberal Arts & general & teacher preparatory	530	41	339	142	6	2
f) Liberal Arts & general, terminal occup. and teacher preparatory	261	113	104	40	2	2
g) Professional or technical	199	6	72	67	43	11
h) Professional or technical and teacher preparatory	77	6	20	32	14	5
i) Professional or technical and technical occupational	32	5	18	5	1	3
j) Liberal Arts & general with 1 or 2 professional schools	140	—	59	61	16	4
k) Liberal Arts & general with 3 or more professional schools	183	—	5	45	133	—
Total	2,040	593	741	455	219	32

Source : U.S. Office of Education. *Education Directory, 1961-62.*

academic research. Indeed, the extent to which quality is concentrated in a small number of nationally known and nationally recruiting graduate institutions is a marked feature of the system. In 1957-58, six institutions awarded a quarter of all the doctors' degrees of that year. A study by Hayward Keniston, in 1957[1], collated judgments of university department chairmen to produce an overall ranking of institutions in which the top ten were :

1. Harvard
2. California (Berkeley)
3. Columbia
4. Yale
5. Michigan
6. Chicago
7. Princeton
8. Wisconsin
9. Cornell
10. Illinois.

(Institutes of Technology were excluded.)

1. Hayward Keniston, *Graduate Study and Research in the Arts and Sciences at the University of Pennsylvania,* Philadelphia, 1959. The pace of development is such that the rank order established in 1957 may be out of date in 1962, but not drastically so.

and this list of names, though not their relative ranks, was unchanged from a previous study in 1925 with the exception of the appearance of Illinois and the disappearance of Johns Hopkins. Thus, the apex of American higher education is made up of a handful of graduate schools most of which are privately controlled, though the rise of the state university of California (Berkeley) from 9th to 2nd place during this period is a highly significant phenomenon. The quality of faculty and students corresponds to this institutional hierarchy, and is examined below. Meanwhile, it may be mentioned that post-war expansion of higher education has resulted in an elongation of the quality pyramid and especially in a transformation at the leading institutions such that, for example, half of the entering class of 1950 at Harvard would not have secured admission in 1958.

TABLE 3. UNITED STATES INSTITUTIONS OF HIGHER EDUCATION BY INSTITUTIONAL CONTROL AND HIGHEST LEVEL OF OFFERING

TYPE OF CONTROL	HIGHEST LEVEL OF OFFERING			PH. D. OR EQUIV.	DEGREES	TOTAL
	2 TO 4 YRS. BEYOND 12TH GRADE	BACHELORS' &/OR FIRST PROFESSIONAL DEGREES	MASTERS' &/OR SECOND PROF.			
PUBLIC :						
State	38	94	162	93	6	393
District or City	308	4	9	6	1	328
PRIVATE :						
Independent of Church	115	183	124	71	19	512
Protestant	84	271	92	23	5	475
Roman Catholic	45	181	65	16	1	308
Other	3	8	3	10	—	24
Total	593	741	455	219	32	2,040

40. The foregoing sketchy outline of American higher education leaves us doubting whether it can be properly called a system. There is, for example, no powerful centralising and unifying force comparable with that in France or Russia or the United Kingdom. Instead, there is competition between many different state and private ventures and which, in the past at least, has served America well. Of course, as we shall see, the extent of federal involvement is immense and growing rapidly. The question in our minds is whether the solution of the approaching manpower crisis and the further advance of the United States into what we have called the third stage of education development will not require more explicit organising action by state and federal agencies.

41. From this point of view, development plans of the California type are of special interest[1]. They seem to us to represent the most advanced

1. *A Master Plan for Higher Education in California, 1960-75*, published by California State Department of Education, Sacramento, 1960.

effort to construct a system of mass higher education (for a tripled enrolment by 1975) while maintaining a quality of research and education at the top which is unsurpassed anywhere among O.E.C.D. countries and probably in the world. The mass base is to be provided for by the development of junior colleges with transfer arrangements to the university and the state colleges, in the upper division[1]. The state colleges represent a higher level of admission quality by restriction of their selection to the top one-third of the graduates of California public high schools, and the university is to cater for the top one-eighth. Thus the three tiers will guarantee tuition-free access to higher education for all California high school graduates and, at the same time, exercise a division of function according to student quality. While the contribution of private institution is not ignored, this emerging structural framework provided by the state may well be the appropriate model for higher education in a society based on the culture of science and technology.

42. The need for expansion which now confronts American higher education will put a severe strain on the nation's resources. Shortages of plant, of faculty, and especially qualified scientists, (of everything except undergraduate students) are already in clear view. The structure of higher education as a whole may be drastically changed in the process of response to what has to be regarded as a crisis. The next generation of Americans will experience the first fully developed system of universal higher education. Public funds and publicly led coordination, on at least a state-wide basis, will be added to the past autonomy of separate institutions. The scale of organisation will increase. The private small college will occupy a less important place[2]. The public junior college will emerge as the basis of popular higher education.

4. RESOURCES FOR EXPANSION

43. In the short run, expansion of the system of higher education in America, as in other O.E.C.D. countries, is enforced by the post-war bulge in fertility. In the middle-run, further expansion is ensured by a rising level of popular aspiration towards college education and its passport to the white collar and professional world. But in the long-run, and therefore fundamentally, the expansion derives from permanent features of a country which has come to base its life and livelihood on scientific culture. With the institutionalisation of research and of professional training for a growing proportion of the labour force, higher education becomes as essential to the national welfare as, say, the family or the medical services.

44. Between 1960 and 1970, enrolment in higher education will double, perhaps more than double. Starting from this assumption, Alice Rivlin has argued that "if the cost of educating a student increases by 25 per cent — which seems conservative — current resources devoted to higher education 10 years from now will have to be two and a half times as great as at

1. i.e. after two years of undergraduate education.
2. But here much will depend upon the energy and ingenuity with which liberal arts colleges pursue schemes for pooling resources to gain economies of scale, as for example at Claremont.

present. This means they will have to increase by more than 10 per cent per year, which is at least twice as fast as the rate at which optimists think (United States) total production is likely to grow in the same period"[1]. This implies a massive re-allocation of resources in favour of higher education if the demand is to be met and the crucial demand for high scientific manpower must be viewed in this context.

45. A U.S. Office of Education estimate of the scale of the problem was issued in January 1961[2]. The two major elements are *staffing* and *physical facilities* and the action required on the latter is described as follows :

> "To achieve the ten-year objective, an aggregate national expenditure (funds from all sources) of some $19 billion will be required for college and university physical facilities over the decade ending in the academic year 1969-70. Of this amount approximately $13.6 billion will be needed to accommodate the anticipated increase in student enrolment ; $1.5 billion for replacement of, and $0.6 billion for rehabilitation of existing facilities ; $1.9 billion for research facilities ; and (overlapping the preceding categories but not included in the other amounts) $1.1 billion for medical and dental schools. Funds for physical facilities (other than for medical and dental schools) required for instructional purpose account for $9.8 billion of the above total, and for residential purposes, $6.0 billion".

46. Formidable as this task appears it must be noted that it is based on a modest projection of demand — an estimate of just over 6 million students compared with the 7.3 million mentioned by Rivlin. Even this may be an under-estimate. Moreover, the total estimates of financial needs for higher education must also take into account student support through scholarships, grants and loans, libraries, laboratories, adult education etc. where efforts comparable to those for staffing and physical facilities will be needed. The total annual budget for higher education by 1970 will undoubtedly have reached a figure several times as large as that for 1960.

47. We shall look at some of the aspects of this great national challenge in the following sections on the supply of students and faculty and of the role of the federal government, later in this section. Meanwhile, the following general implications may be drawn :

1. It seems clear that the major burden of financial support must be borne by governmental sources ;
2. The tradition of federal support for education by indirect means (that is, by support of particular activities) is likely to be called in question, and pressure is likely to increase for a policy of general aid to higher education ;
3. The need to search for new ways to pedagogical efficiency and the most effective allocation of trained manpower between competing demands in business, government and education is likely to become a crucial issue ;

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1. Alice M. Rivlin, *The Role of the Federal Government in Financing Higher Education*. The Brookings Institution, 1961.

2. U.S. Office of Education. *Ten Year Objectives in Education. Higher Education, Staffing and Physical Facilities 1960-61 through 1969-70*. Washington 17th January, 1961.

4. The capacity of different states to meet the financial demands of the '60's varies markedly, as does the current level of educational expenditure. Thus the percentage of personal income spent on public education through state appropriations varies from 1.34 per cent in New Mexico and Utah to 0.16 and 0.13 per cent in New York State and Massachusetts respectively[1]. By and large, the state effort in proportion to income of the population is greatest in the West, average in the South, and lowest on the Eastern seaboard. The authors of the California master plan — California ranking 34th from the top on this criterion with a percentage of 0.46 — conclude that "California can and will, as in both the past and the present, provide adequate support for an efficient programme of public higher education designed to meet fully the rapidly changing needs of society"[2].
Many of the poorer states cannot look forward realistically with such optimism. From a national point of view, inequalities of wealth among states are likely to reduce the effectiveness of the response to financial need.
5. The general position of private colleges and universities is likely to weaken unless drastic action is taken. There will probably be increasingly severe competition for private gifts, and this will bear most heavily on the smaller and weaker institutions. This is likely to set in motion : a vicious spiral of lowered capacity to compete for highly qualified and increasingly costly faculty ; reduced standards of plant and facilities ; and lowered standards of output both qualitatively and quantitatively.

The Financial Role of the Federal Government

48. Direct aid to higher education is not in the tradition of American federal government. Educational aid has tended to be a by-product of other governmental efforts to spend in the national interest on health, agricultural progress, defense, the conquest of nature and space, and the welfare of returned soldiers. It therefore turns out that colleges and universities have hitherto relied on the other sources of income, viz tuition and fees, gifts and endowment earnings, and state and local government support for the financing of most of their activities. Except in the high tide of the G.I. bill after World War II, federal income has been predominantly income for research, and if research income is ignored and only that which goes directly towards the teaching of students is examined, then the federal contribution in 1957-58 came to 4 per cent compared with 42 per cent from state and local government, 36 per cent from tuition and fees, and 18 per cent from other sources.

49. If higher education needs an annual budget of $10 billion in 1970, it is difficult not to agree with Alice Rivlin's conclusion that the federal government ought to become a major source *by direct contribution to the teaching functions of higher education.*

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1. *A Master Plan for Higher Education in California 1960-1975*, Sacramento, 1960. p. 185, Table 35.
2. *Ibid* p. 196.

50. The difficulties in the way of this outcome are, of course, immense. There are intellectual arguments against all forms of public expenditure on higher education, state or federal, based on belief in the market as the most efficient instrument for the allocation of scarce means between competing ends. There are political problems concerning the allocation of federal money between different states and between different types of institution. There are even constitutional problems concerning the separation of church and state in the granting of aid to church-linked colleges.

51. Nevertheless, in our view, leaving aside the merits and demerits of alternative methods of support, the need for a substantial and immediate increase of federal effort seems to be inescapable. The needs of 1970 are elaborated in a publication of the Office of Education[1]. The arguments for federal leadership in their solution are set out in persuasive detail by Rivlin[2].

In summary these are :

> "The federal government probably is going to have to relieve the states of some of their growing fiscal burdens in the next 10 years and higher education is a particularly appropriate burden for the federal government to relieve. This is because of the relation between education and national security, because of the inter-state mobility of college students and graduates and because of the national interest in reducing the disparity in opportunities for young people from different parts of the country".

Still more shortly, it may be put that federal aid can give the country an even coverage of opportunity for ability in high-standard institutions of higher education.

5. THE SUPPLY OF UNDERGRADUATES

The General Picture

52. The prospective gap between supply and demand in high scientific manpower is paradoxical in the context of the general expansion of higher education in America where the flow of students from secondary to higher institutions has reached proportions which are unprecedented in human history and which show no sign of slackening. This mounting tide of college students, while itself a not so indirect result of the burgeoning scientific culture, affects both sides of the equation of scientific manpower. From it will come the supply of scientists (and new science) and to it must be attached a significant element of the existing trained manpower as teachers and research workers.

53. We shall see that, if all the resources of higher education were marshalled directly to the task of closing the 'science and technology gap', if, that is to say, higher education were treated solely as a training organization for science and technology, the problem would be easily manageable. In other words, just because one of the results of the productivity of

1. See Note 2, p. 25.
2. See Note 1, p. 25.

science and technology in a free society is a consumption demand for education, there is generated a shortage of scientists and technologists.

54. It is therefore necessary to examine the output of scientists and technologists in the context of the total flow of students into college and university. We may then narrow the focus onto the segment which is channelled into science and engineering. In this way we are able to ask not simply whether the flow will be enough but also whether it will not be *too much* to meet the crucial demand for scientists and technologists. In examining the total flow we can also estimate how far it collects the potential talent among the nation's children, and how far the talent collected is then channelled off to non-scientific studies.

55. The total flow of students into degree-credit courses is summarised in Table 4. There were over $3\frac{1}{2}$ million in 1960, and projections for 1970 vary upwards from 6 million compared with $1^1/_3$ million before World War II. Related to the population of ages 18-21 this means that 37.2 per cent of young Americans are now active degree seekers and that the pro portion will rise to 47.6 per cent in 1970. A recent poll by Elmer Roper indicates that this may be an underestimate. His results suggested that up to 60 per cent of the relevant age group may aspire to college education in the 1960s ; this proportion has already reached 50 per cent in the more prosperous areas, for example California.

TABLE 4. TOTAL DEGREE ENROLLMENT IN RELATION TO POPULATION AGED 18-21 IN UNITED STATES BY SEX.

YEAR	ESTIMATED POP. 18-21 YRS. (IN THOUSANDS)	TOTAL DEGREE ENROLLMENT	RATIO : DEGREE-CREDIT ENROLLMENT TO 100 OF POPULATION 18-21		
			TOTAL	MEN	WOMEN
1939	9,582	1,364,815	14.2	17.1	11.4
1950	8,948	2,281,298	25.5	34.7	16.2
1955	8,577	2,653,034	30.9	40.0	21.7
1960	9,605	3,570,018	37.2	46.3	27.8
1965	12,153	5,203,000	42.8	—	—
1970	14,573	6,936,000	47.6	—	—

Source : U.S. Office of Education : *Opening (Fall) Enrollment in Higher Education, 1960 : Analytical Report.* Washington, 1961.

56. Another way of looking at this potential supply of students is to consider high-school graduation. In 1959-60, there were slightly over 1,800,000 high-school graduates. In the fall of 1960, there were 929,823 first time degree-credit enrolments. This implies that just over half went on to college-degree work, and to these must be added those who entered technical institutes and other forms of post-secondary schooling which are not credited towards the bachelor's degree. The recent history of high-school enrolment and retention again points to a rising tide of potential

degree seekers. Thus 68.7 per cent of those who entered grade 9 in 1956-57 went on to graduate in 1959-60, compared with 60.4 per cent of those who entered grade 9 in 1946-47.

57. In summary, the outlook for the 1960's is one of increased high-school enrolment with an increasing proportion staying on to graduate, and an increased proportion of these entering college to study for degrees.

58. But not all college entrants graduate. A recent estimate is that about 60 per cent of those who enter college go on to get a bachelor's or equivalent degree somewhere at some time. Thus we may infer that, in the 60s, out of every 100 young Americans 70 will graduate from high-school, 35 will read for degrees and 21 will get them.

59. These are impressive figures. Yet, while there are large numbers of young people who qualify for entrance to college but then drop out before graduation, it is worthwhile to enquire who falls by the wayside.

Obstacles to Educational Opportunity and Attainment

60. Before exploring its shortcomings it is appropriate to re-emphasise the scale of American achievement in giving educational opportunities to more young people, both absolutely and proportionately, than any other nation. If the example of the more progressive states establishes itself throughout the nation then not only primary and secondary but also junior-college education will emerge as universally available in the 1970s.

61. An essential question to ask about educational provision concerns the extent of its availability to, and use by, those with high ability. For the top 30 per cent of ability in the nation as a whole, a recent N.S.F. analysis of research findings concluded that 55 per cent of the boys and 70 per cent of the girls are lost at some point before graduation. Even more serious, taking the top 10 per cent, the potential intellectual leaders, the report estimates a 44 per cent loss of boys and a 59 per cent loss of girls. While this means that young people of high ability stand an excellent chance of entering, and graduating from, college (Wolfle estimated[1] that college entrants had an average A.G.C.T.[2] score of 115 and college graduates 121), we are forced to conclude that the educational use of potential ability in this, the most open of educational systems, remains far short of perfect. The question therefore arises as to what is being done or can be done to create a closer relation between potential ability and educational performance. But there is another question of great importance and complexity, i.e. ought the relationship to be closer?

62. The 'meritocracy' question is familiar ground. In a recent O.E.C.D. conference which focused on the relation between ability and opportunity in the much less open educational systems of Europe, a clear consensus on policy emerged that, under present conditions, the educational search for talent would be justified fully on both the principle of individual enrichment and that of social efficiency[3].

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1. *America's Resources of Specialised Talent*, 1954.
2. Army General Classification Test.
3. See Halsey A. H. (ed.) *Ability and Educational Opportunity*, O.E.C.D. Paris 1961.

63. Neither the expansiveness of American education nor the wastage figures for high talent would suggest that these arguments are inapplicable to the American case. Nevertheless, it may be worth pointing out not only that national efficiency and individual freedom may collide at some point in the ever-tightening relation between education and economic organisation, but also that there may be some latent compensations for inefficiency in educational selection. As things stand, much potential ability in the United States continues to go unadorned by academic degrees. Can we assume that this educational waste represents an equal loss of social utility? An affirmative answer can be given only if we assume also that present education is perfectly attuned to future economic need, and that potential talent should be sieved exclusively through formal educational processes. There can be no doubt that for the maintenance of a modern economic system the educational channelling of talent must take high priority — a higher priority than is reflected by current practice — but not perhaps as absolute claim.

64. The barriers to educational opportunity are complex, and of varying susceptibility to amelioration by social policy. Lack of funds is easily translatable into policy terms, at least in principle, but seldom stands alone in contemporary America. The context of a web of familial, community and psychological forces which affect the level of motivation of individuals possessed of different native endowments must also be considered. The outline of this constellation of forces is known and has internationally common features[1]. The offer and the acceptance of educational opportunity is correlated with family income and status, intelligence, sex, urban-rural location, social composition of neighbourhood and school, ethnicity, size of family, religious affiliation, etc.

65. Our impression of the trends and possibilities among these correlates in the United States are as described below.

Motivation

66. There is a widespread need for the development of a comprehensive system of educational guidance at all stages, but especially at the secondary stage. Conant has recommended that guidance should begin in primary school and that there should be a qualified full-time counsellor for every 250-300 pupils in secondary school; this problem was recognised in the National Defense Education Act of 1958, with its provisions for guidance, counselling and testing. By 1960, there was a counsellor for every 610 pupils in secondary schools. The further development of this movement seems to offer the most direct approach that is available to public policy towards raising motivation among potential college graduates.

The Costs of Education

67. This correlation is complex. Both average family income and educational costs may be expected to rise in the '60s. The rise in costs was particularly marked from 1956-60, as may be seen from Table 5 taken

1. c.f. *Ability and Educational Opportunity*, O.E.C.D. Paris 1961.

from a recent study by Elmar West. Of the total increase in college costs between 1928 and 1960, approximately one-third took place in the last four years. On the other hand, average family incomes rose 14 per cent in these years and enrolment is increasing fastest in the less-costly public institutions. Moreover, both scholarship and loan funds have become more readily available in recent years.

TABLE 5. COSTS OF COLLEGE EDUCATION 1928-1960
U.S. Dollars per annum

TYPE OF INSTITUTION	TOTAL COSTS (TUITION FEES, ROOM & BOARD)				
	1928	1940	1952	1956	1960
Large Public (State Resident Students)	405	461	731	819	988
Small Public (State Resident Students)	366	406	655	722	846
Large Public (Non Resident Students)	454	565	950	1,076	1,316
Small Public (Non Resident Students)	403	478	791	908	1,143
Large Private	733	739	1,220	1,439	1,855
Medium Private	536	629	1,080	1,275	1,639

Source : Elmer West "Is Education Becoming Too Expensive ?" *College and University Business,* June 1961.

68. Nonetheless the pattern of rising costs is not to be taken lightly, and costs are now rising more steeply than incomes. Thus it is appropriate to underline the advantage of providing undergraduate and post-secondary education within commuting distance of home for as many young people as possible, and there is evidence that the proximity of institutions of higher education is a factor in its own right determining the level of college attendance.

SCHOLARSHIPS, LOANS, OTHER FINANCIAL AIDS

69. While it seems reasonably clear that financial stringency can seldom prevent anyone who is sufficiently motivated from getting some kind of higher education, we are nevertheless convinced that financial aid from public sources could contribute substantially to the reduction of wastage among high-ability youth. In his message to Congress on February 5th, 1962, the President put the case as follows :

> "... more than 400,000 high-school seniors who graduated in the upper half of their class last June failed to enter college this fall (1961). In this group were 200,000 who ranked in the upper 30 per cent of their class, of whom one third to one half failed to go on to college principally because of lack of finances...".

The president therefore went on to urge the enactment of the proposal before Congress which deals with assistance to higher education "including scholarships for more than 200,000 talented and needy students and cost of education payments to their colleges...".

70. While we have the impression that a general undergraduate scholarship programme has considerable support in Congress, the position at the

time of our visit was that two versions of a new Higher Education Bill were under consideration. The Senate version provided for scholarships, the House version did not. Meanwhile, the major federal effort in aiding undergraduates takes the form of loans under the National Defense Education Act of 1958. (It was frequently pointed out to us in both political and academic circles that federal aid for education is more easily secured for non-educational than for educational purposes.) In a report on the Act for the fiscal year ending June 30th, 1960, the U.S. Office of Education indicated that loans totalling over $ 50 million were paid to 115,450 undergraduate and graduate students in 1,357 colleges and universities. The average loan was $ 434, and the total amount loaned was five times greater than in fiscal year 1959.

71. It seems that this N.D.E.A. loan programme has made strong impact on attitudes towards paying for higher education, and that the idea of borrowing for this purpose fits in with an 'investment' outlook which is widespread among Americans. The authors of the Report point out that, "other than the thousands of students it has benefited, the most important result of the student loan programme has probably been its contribution to an almost revolutionary change in attitude toward the use of loans in enabling students to meet the costs of higher education... 639 of the 1,357 institutions participating never had loan funds on their campuses before, and institutions which had loan funds but which used them in only a very limited way are now greatly expanding their loan activity"[1].

72. Several institutions visited by us confirmed a further effect, viz, that they are now adopting a comprehensive approach to the whole problem of student financial assistance linking all their resources of scholarships, loans, grants and part-time employment opportunities and fitting them to each individual case of financial need.

73. Nevertheless, our overall impression of the undergraduate situation is that the supply of assistance continues to fall short of the demand for it. The scholarship gap is felt to be most serious by many academics and there is evidence that "students who come from higher socio-economic groups are more frequently awarded scholarships than students from lower classes, whether financial need is a criterion or not, perhaps because the former want to attend expensive 'name' colleges whereas the latter are content with colleges which are cheaper and less well known"[2] The best known of the private sources of undergraduate scholarships is the National Merit Scholarship Corporation, which awards 900 four-year undergraduate scholarships annually on the results of a national competition among high school seniors. The Corporation was established in 1955 and is supported mainly by the Ford Foundation which gave an initial sum of $ 20 million, and added $ 14.5 million in 1962 to ensure the continuation of the scheme until 1970. Many other philanthropic and industrial bodies have contributed : in fact $10.8 million of the $ 25 million given

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1. The Act requires the student borrower not only to take an oath of loyalty to the United States but also to sign an affadavit disclaiming disloyal associations and beliefs. We cannot but regard this provision as silly and the refusal of Harvard and other colleges to take part in the scheme because of it as justified.

2. Holland J. and Kent L. "The Concentration of Scholarship Funds and its Implication for Education". *College and University*. Summer 1960.

in scholarships to date has come from these sources. The average award is $ 800 per annum depending on an assessment of need and in addition a grant is usually made to the college in which the student enrolls as a contribution to the cost of his education.

74. The scheme seems to have an enlivening effect on secondary education as a competitive spur and a stimulus to academic ambition. The criticisms we heard have been concerned with the small numbers of scholarship winners and their tendency towards concentration among a few prestigeful institutions.

75. The outcome of the current debate will be of the greatest interest for the many O.E.C.D. countries which are going through the early stages of expansion in higher education. The United Kingdom, with its restriction of entry, its low rates of drop out and its 95 per cent scholarship support[1] stands at the opposite extreme in higher educational organisation. The United States is engaged in the task of securing mass higher education combined with adequate support to the intellectually outstanding, whatever his financial background.

Proximity of Educational Institutions

76. We have already noted the proximity factor as an element in the cost of higher education. In its own right proximity also affects the 'visibility' of educational opportunity and therefore plays a part in the development of community attitudes towards extended schooling. Research studies have established a correlation between geographical proximity to college and likelihood of attending college. But the issue is again a complex one. Our impression is that, while the efforts being made in many states to place junior colleges and state university centres within easy reach for all lower-division students are wholly admirable, it is equally necessary to ensure that the financial backing is also available to enable students of superior ability to experience the challenge of accelerated programmes in more selective institutions.

Clearing Houses

77. We should like finally to draw attention to what struck us as the remarkable uncertainty, even chaos, of information about opportunities for higher education which the secondary school student and his parents (who probably never went to college) must face. This is partly a question of the educational guidance service to which we have already referred, but we were able to trace the existence of only three small clearing houses on the whole continent of the United States. Knowing that clearing house arrangements are already being developed in the much simpler circumstances of university education in the United Kingdom, we are led to wonder whether action along similar lines by states, or groups of states might contribute largely to the guidance of students towards appropriate institutions.

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1. Russian estimates are uncertain and disputed : the comparable proportion is probably 70-80 %.

The Share of Science in the Supply of Undergraduates

78. Whatever success is attained in reducing general wastage between high school and college graduation, it is clear that the United States has a large undergraduate pool from which to draw its supply of scientists and technologists. The problem therefore seems to be not so much one of raising the total supply of undergraduates but of raising the proportion of undergraduates equipped to read, and actually reading, science and engineering. The proportion in the last three years of the 1950's was rising slowly, and was roughly one-fifth (Table 6). This seems rather low. It is certainly much lower than the proportion of undergraduate scientists and technologists in the Russian and British universities.

79. In Britain in 1959-60, 45 per cent of the undergraduates were reading pure or applied science (in approximately equal numbers) and over the past six years increasing enrolment has been two to one in the sciences as compared with the arts. The Russian comparison is perhaps even more telling. DeWitt's study[1] shows that the higher educational system of the U.S.S.R. produces more than twice as many graduates in science and technology on roughly two-thirds the enrolment base. Thus 7 per cent of the relevant Russian age-group graduate compared with 12 per cent in the United States, but 57 per cent of the Russian graduates in 1959 were scientists or ingineers against a U.S. figure (according to DeWitt) of 24 per cent.

80. It is true of course that the United States has a well-developed quaternary or graduate educational system, which is more strongly oriented towards science and technology. Nevertheless it seems reasonable to us to draw the conclusion that the undergraduate and secondary school

TABLE 6. DISTRIBUTION OF EARNED BACHELORS DEGREES 1957-60 BY FIELD OF STUDY

In percentage.

	BACHELORS AND PROFESSIONAL DEGREES		
	1957-58	1958-59	1959-60
Physical Sciences	3.9	4.0	4.1
Biological Sciences	3.9	3.9	4.0
Maths. & Statistics	1.9	2.3	2.9
Engineering	9.7	9.9	9.6
Total of Above	19.4	20.1	20.6
Agriculture & Forestry	1.8	1.7	1.6
Architecture	0.4	0.4	0.5
Health Professions	6.5	6.3	6.2
All others	71.9	71.5	71.1
Total	100.0	100.0	100.0
(N)	(365,748)	(385,151)	(394,889)

Source : NEA. *A Fact Book on Higher Education.* p. 92.

1. *Soviet Professional Manpower,* Rev. Ed. 1961.

emphasis should be shifted. More particularly we would say that the efforts, notably of NSF, to raise the quality and quantity of science and mathematical education in high schools and liberal arts colleges should be encouraged as much as possible by public policy.

TABLE 7. GRADUATE STUDENTS FALL 1960 BY FIELD OF STUDY

	TOTAL	TOTAL		TERMINAL YEAR PH. D. STUDENTS		
		FULL-TIME	PART-TIME	TOTAL	FULL-TIME	PART-TIME
Forestry	560	451	109	21	17	4
Agriculture	3,852	2.489	1,363	416	242	174
Architecture	585	426	159	5	5	0
Biological Sciences	14,775	9,564	5,211	1,394	969	425
Mathematics & Statistics	11,770	5,104	6,666	446	268	178
Physical Sciences	25,707	15,045	10,662	2,466	1,800	666
Engineering	36,636	14,698	21,938	1,516	893	623
Health Prof.	5,842	4,312	1,530	227	138	89
Social Science	37,317	20,374	16,943	1,624	922	702
Psychology	10,677	5,229	5,448	917	380	537
Geography	1,041	616	425	64	33	31
Business & Commerce	25,342	7,474	17,868	321	154	167
Home Econom.	1,580	797	783	38	26	12
Education	94,993	15,578	79,415	1,895	713	1,182
English & Journalism	13,463	6,476	6,487	503	274	229
Fine & Applied Arts	9,255	5,208	4,047	390	228	162
Foreign Lang. & Literature	6,310	3,636	2,674	371	223	148
Law	1,651	323	1 328	38	15	23
Library Sc.	1,360	507	853	21	7	14
Philosophy	2,258	1,476	782	189	116	73
Religion	5.314	3,675	1,639	493	338	155
Miscellaneous	4,061	1,231	2,830	47	24	23
Total	314,349	124,689	184,660	13,402	7,785	5,617

Source : U.S. Office of Education.

6. THE SUPPLY OF GRADUATE STUDENTS

81. In the autumn of 1960, the total number of students enrolled for advanced degrees in the aggregate United States (i.e. including Alaska and Hawaii) was 314,000 in 605 colleges and universities. This represents an increase of 9,000 students and 33 institutions compared with the previous year, and a rising trend is discernible throughout the 1950's on which were superimposed the temporary inflations caused by returned veterans from World War II and the Korean War. Of the 314,000 students, 125,000 were full-time (39.8 per cent)[1]. Their distribution by discipline in the autumn of 1960 is shown in Table 7. Berelson[2] estimates that about

1. Office of Education, *Circ. 54009-60*, September, 1961.
2. B. Berelson, *Graduate Education in the United States*, 1960.

half of all graduate students are doctoral candidates. The Office of Education estimated that 10,500 would complete doctorates in 1960-61.

82. The attainment of a Ph.D. usually involves geographical (and often social) mobility. Only about a quarter of doctoral recipients take their degree in their own state, and well over half come from families where the father had not gone beyond high school in his own education. The majority — about two thirds — come from the undergraduate divisions of universities, but emphasis is often given to the role of liberal arts colleges such as Oberlin, Dartmouth and Swarthmore because of the high proportion of the baccalaureates of these high-quality colleges who go on to take doctor's degrees. The main feature of the institutional system however is that there is heavy concentration of recruitment from the 900-odd undergraduate schools. Of these, 95 were responsible for producing 74 per cent of all those who went on to get a Ph.D. between 1936 and 1956. The trend towards higher undergraduate enrolment in public universities rather than private liberal arts colleges may be expected to reduce the importance of the latter as feeder institutions to the graduate schools. Moreover the widespread criticism of liberal arts colleges that they are relatively weak in science is supported by the distribution of N.S.F. fellowship (Table 8), which reflects the fact that these awards are for science. It also indicates a strong orientation to scientific research on the part of those who judge the candidates.

TABLE 8. UNDERGRADUATES, ORIGINS OF N.S.F. FELLOWS (1st YEAR). 1954-1959

Top Universities	53%
Other Universities	38 %
Colleges	9 %
	100 % (4.163)

Source : Berelson Graduate Education in the United States, p. 132.

83. Both Berelson and Orlans[1] report favourably on the quality of the American graduate student, whether by reference to the trend from pre-World War II or in terms of absolute capacity for doctoral-level study.

84. This generalisation appears to hold in circumstances where, for the system as a whole, there are so far no more applicants than places. The answer to the problem of producing more doctorates is therefore one of increasing the flow from the undergraduate schools. Less than one in eight survive from undergraduate to graduate enrolment : and Wolfle showed[2] that, of all male college graduates with the intelligence of the average Ph.D. (i.e. AGCT score 130+), only about 5 per cent now get the doctorate. But, as Berelson points out, the proportionate 'wastage' of talent varies between disciplines. The number of doctorates in the physical and biological sciences is 12 to 14 per cent of the number of graduates in

1. Harold Orlans, *The Effects of Federal Programs on Higher Education,* The Brookings Institution, 1962.
2. Wolfle, *American Resources of Specialised Talent.* Harper and Bros, New York.

those fields four years earlier as against 4 to 5 per cent of those in the social sciences and humanities.

85. We have been left in little doubt from the literature and from our questions at universities and colleges that the main problem of raising the supply of graduate students is not one of the potential quality of baccalaureates but the problem of financial support. In this connection, it must be noted that graduate students are usually married and often have children. The typical pattern of life among graduate students is that they seek a free education with an additional income capable of supporting themselves and their families. The situation is summarised in Table 9 taken from Berelson.

TABLE 9. GRADUATE STUDENT SUPPORT BY TYPE AND FIELD

In percentages.

	SUPPORT OUTSIDE MY OWN FAMILY REQUIRING NO WORK FROM ME e.g. A FELLOWSHIP	SUPPORT REQUIRING WORK THAT CONTRIBUTES TO MY DEGREE, e.g. A RESEARCH ASSISTANTSHIP USED FOR DISSERTATION	SUPPORT REQUIRING WORK THAT DID NOT CONTRIBUTE DIRECTLY TO THE DEGREE e.g. A TEACHING ASSISTANTSHIP	ANY OF THESE
Physical sciences	51	53	75	97
Biological sciences	45	47	62	97
Social sciences	45	28	64	87
Humanities	53	7	63	83
Engineering	48	52	62	95
Education	28	13	48	72
Total Arts & Sciences	48	37	67	92
Total Professional Fields	35	27	51	80
Grand total	44	33	61	88

Source : B. Berelson, *Graduate Education in the United States*, p. 149.

86. Berelson's estimate is that the number of fellowships, teaching assistantships and research assistantships, from all sources, is approximately the same as his estimate of the number of full-time doctoral students in residence (i.e. 60,000 to 70,000). Since World War II, federal fellowship programmes have developed on a considerable scale. According to Rivlin, about 6,000 pre-doctoral students held full-time federal fellowships in 1960-61, all but about 2,000 of them in the sciences. The total includes 2,500 National Defense fellows, 2,400 N.S.F. fellows and 1,000 N.I.H. fellows. Altogether, this means that about 10 to 15 per cent of the doctoral candidates have full-time federal fellowships and the proportion is much higher in the sciences. The remainder get some sort of support from research or teaching fellowships.

87. There can be little doubt that the efforts of the federal government through N.D.E.A., N.S.F. and N.I.H. have materially improved the finan-

cial situation for graduate students in recent years, especially in the sciences and engineering, and that the Woodrow Wilson and other programmes (including university funds) have maintained something of a balance in the support to other fields. Nevertheless, we must raise the question, to which the fact that the average completion of the Ph.D. takes 5 or 6 years adds point, whether a more generous fellowship programme — e.g. of the scope suggested by President Truman's *Commission on Higher Education* — would not raise the efficiency of graduate education and the numbers seeking entrance to it. There are, we know, strong arguments against this. The investment argument put by such economists as Milton Friedman is stronger the later the stage of education to which it is applied. And the loan type of support fits well into the temper of American opinion. Fellowship programmes, too, can be shown to have created problems for the universities, for example in finding teaching assistants. Perhaps fellowship programmes should be fitted into the scheme of support advocated by Berelsen, viz, fellowships in the first year, research and teaching assistantships in the second and third years, and a loan in the fourth year. Graduate fellowships are not the sole solution to the problem of raising numbers, and they cause difficulties for institutions to which we shall return. Nevertheless it seems reasonably clear that they have a vital role to play in the problem of increasing the efficiency of graduate education by reducing the time taken to complete the doctorate[1] and by reducing the rate of attrition which is estimated to be of the same order as that for undergraduates, i.e. 40 per cent.

88. Berelsen estimates that there are more than 10,000 so-called A.B.D.'s ("all but dissertation"), the majority of whom should be encouraged to finish. In practice, this means giving them time off from employment to devote to the dissertation. The Office of Education reports, on the basis of a canvass of opinion among graduate school deans, that there are at least 4,000 persons now engaged in teaching who could complete the doctorate if supported for one full year of additional graduate work. A programme designed to enable these people to complete their qualifications would mean something more than a formal and quantitative addition to the doctorally qualified group.

The Share of Science in the Supply of Graduate Students

89. We concluded that the major problem at the undergraduate level was to increase the share of science and technology in the total supply. In this section we have noted that the survival rates from college to graduate school are greater for the sciences than for other disciplines. Thus the proportions of graduates reading science shown in Table 10 are higher than the comparable undergraduate figures shown in Table 6. The problem therefore at the graduate level is more one of raising the total supply of students and this, as we shall see in the next section, is especially urgent in the case of doctorally qualified teachers for higher education.

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1. It was put to us at the California Institute of Technology that the fellowship type of support can reduce completion time for science doctorats by one or even two years.

TABLE 10. DISTRIBUTION OF EARNED HIGHER DEGREES BY FIELD OF STUDY 1957-60

In percentages.

FIELD OF STUDY	MASTERS			DOCTORATES		
	1957-8	1958-9	1959-60	1957-8	1958-9	1959-60
Physical Sciences	4.6	4.6	4.5	18.5	19.4	18.7
Biological Sciences	2.6	2.9	2.9	12.6	11.2	12.3
Maths and Statistics	1.9	2.2	2.4	2.8	3.0	3.1
Engineering	8.8	9.7	9.6	7.2	7.6	8.0
Total of above	17.9	19.4	19.4	41.1	41.2	42.1
Agriculture and Forestry	1.6	1.7	1.6	3.0	4.1	4.5
Architecture	0.4	0.4	0.4	0.1	0.1	0.2
Health Professions	2.6	2.6	2.5	1.6	1.6	1.1
All others	77.5	75.9	76.1	54.2	53.0	52.1
Total	100.0	100.0	100.0	100.0	100.0	100.0
(N)	(65,614)	(69,497)	(74,497)	(8,942)	(9,360)	(9,829)

Source : NEA. *A Fact Book on Higher Education.* pp. 93-4.

90. It can hardly be doubted that the supply of doctorates is not limited by the potentialities of the population. Less than half of one per cent of the relevant age group, and fewer than one in twenty of those in the top one per cent of measured intelligence now achieve the Ph.D.

7. THE SUPPLY OF TEACHERS IN HIGHER EDUCATION

91. The period since World War II in the United States has witnessed many alarms and forebodings concerning education. One persistent theme in all this has been the imminent prospect of an inadequate supply of teachers to meet the rising demand from enlarged enrolments. Both the projected spurt in demand for scientific manpower and the anticipated upsurge of enrolments have now centered the discussion on the supply of teachers in higher education. It has been put to us that this is the bottleneck in the task of raising the output of scientists and engineers.

92. A period of cultural change will tend to generate a shortage of teachers capable of transmitting the new knowledge. A society that commits vast resources to the pursuit of new knowledge in science and technology will produce universal demands for teachers of science, mathematics and engineering, as well as competing demands for the services of similarly qualified people in research establishments, industry and government. The anticipated expansion of American colleges and universities, the space programme, the rising generosity of government and the foundations towards academic research, the demand for help from the under-developed world — all these forces will combine in the next few years to put an unprecedented strain on the supply of teachers of science especially, but also of teachers generally and at all stages of the educational process. The problem is exacerbated by the rate of change in the structure of

scientific knowledge and which leads to a formidable problem of obsolescence of people and to widespread complaints by teachers at one stage of education about the inadequacies or inappropriateness of the education offered to students at the preceding stage. If education as a whole is to remain an integrated process, the advance of knowledge must imply a considerable and continuing investment in the periodic re-training of teachers.

93. Moreover the difficulties of the schools and colleges are increased by a tendency for academic salaries in all industrial countries to lag behind those of comparable jobs in industry. The word *comparable* may be stressed, for the modern connection of science to society is such that the functions of education (teaching and research) are by no means confined to formally constituted academic establishments.

94. The problem may be divided into two — quality and quantity — on both of which there is disagreement concerning the situation that is likely to develop in the United States by 1970. We shall tackle the quantity problem here, and the question of quality in the next section. The main published sources are documents by the Office of Education[1], the National Education Association[2] and Berelson's *Graduate Education in the United States*. The first two authorities arrive at pessimistic conclusions, the last is cheerful. The N.E.A. concludes that "with a continuance of the present level of support the employing officer has no alternative but to choose between an insufficient number and an inferior quality of teachers". Berelson concludes "that the sense of crisis that makes discussions of graduate education sound shrill these days is unwarranted and misleading... The numbers game is by no means lost".

95. We shall hope for resolution of these contrary opinions at the confrontation meeting, as well as for further clarification of the methodological problems involved in making the projections needed for this kind of long-term supply and demand analysis. In the meantime, however, from both our conversations in universities and colleges, and the critical appraisal of Berelson's analysis which follows, we have no hesitation in endorsing the pessimistic school of thought.

96. The estimated needs of college and university teachers in 1970 depend upon four estimates or projections. First, how many potential college-attenders will there be ; second, how many of these will go to college ; third, how many of these will get doctorates and, fourth, how many of these will go into teaching in institutions of higher education.

97. The first projection presents no difficulties. The college age population will rise from 9,600,000 in 1960 to 14,600,000 in 1970.

98. The second estimate depends upon the assumed trend of college-going intentions. Published figures of the enrolled proportion also vary because of differing definitions of college, of the relevant age-group, and of what to do about part-time students. The projections accordingly vary from 4.5 to as much as eight million. Berelson, the Office of Education

1. Office of Education, *Ten year Objectives in Education : Higher Education Staffing and Physical Facilities 1960-61 through 1969-70*, January 17th 1961.

2. N.E.A. : *Teacher Supply and Demand in Universities, Colleges and Junior Colleges, 1959-60 and 1960-61.*

and the N.E.A. all settle for an intermediary figure of six million or just over.

99. The Office of Education statistics offer an estimate of the third projection. They indicate that during the past 5 years the graduate schools have produced some 44,437 doctorates — an average of 8,880 per year — and project a rise in annual output to 18,100 by 1970. This projection is cumulated in Figure 2 along with the cumulated supply which would develop if the 1959-60 rate continued unchanged. (It is noticeable that the later the date of the estimate the higher it is. Wolfle projected a cumulative total for 1970 of 135,000 from 1954. The Office of Education estimated 133,000 from 1959 to 1969). It is not possible to be sure of the accuracy of this third projection. Much will depend on the capacity of graduate schools to expand output with existing facilities and faculty and whether a programme for mopping up the ABD's[1] is developed, and so on.

100. Fourth, the Office of Education estimate that 60 per cent of doctorates enter or continue in employment in higher education. This gives a cumulated supply of 80,000 between 1959 and 1969.

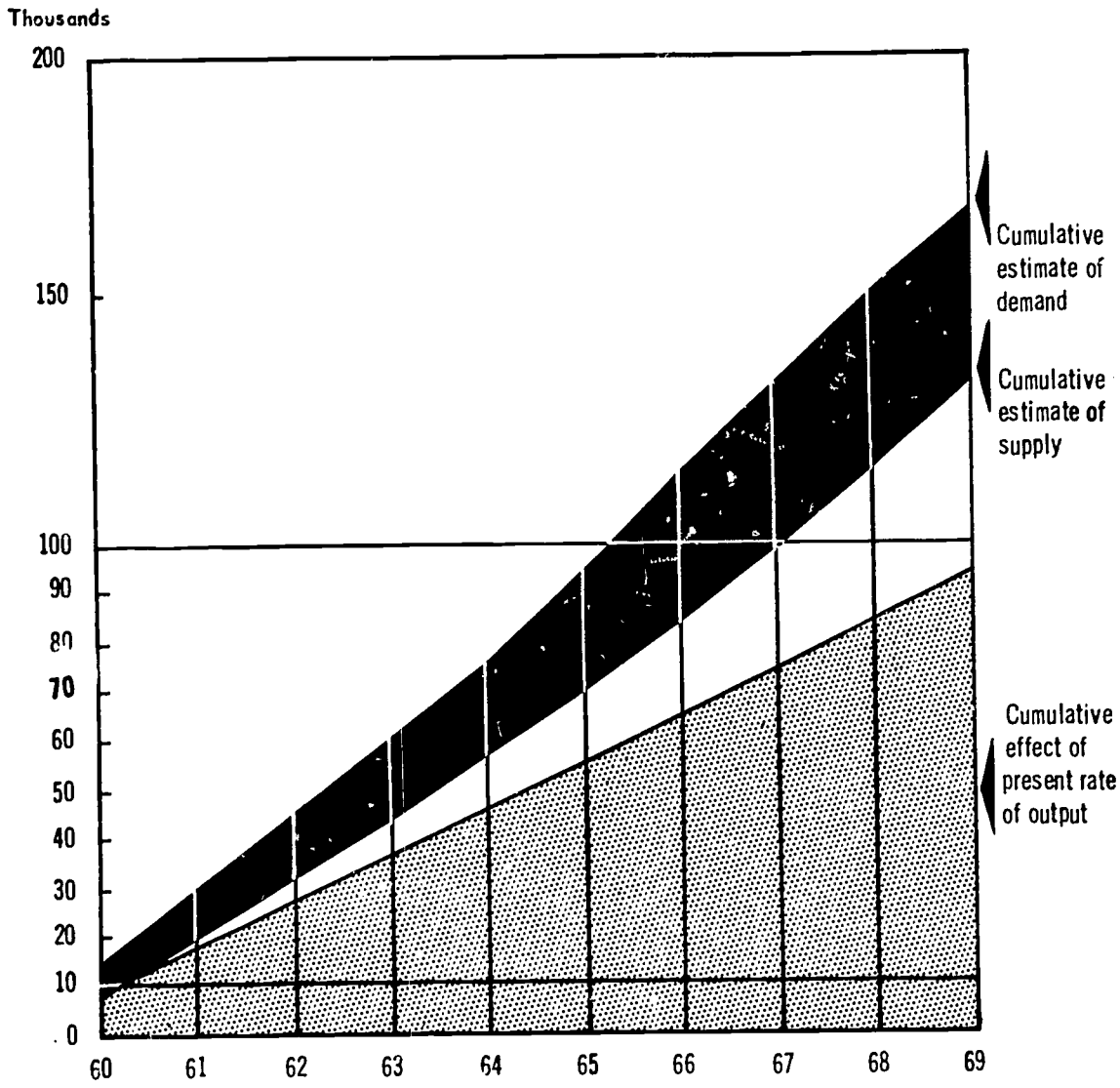
101. Now, let us turn to the demand side. The demand depends upon (1) enrolment ; (2) staff-student ratio, and (3) the proportion of faculty required, or desired, with doctorates.

102. Accepting the enrolment figure of six million, assuming a deterioration of 20 per cent in the ratio of staff to students and assuming an annual replacement rate for deaths, retirements, etc., of 6 per cent for teaching and administrative staff and 7.5 per cent for research staff, the Office of Education projects a cumulative need for 336,000 new professional staff in institutions of higher education between 1960-61 and 1969-70. Assuming further that, to maintain an appropriate quality, 30 per cent of these new recruits should be Ph.Ds. the required output of doctorates in the decade is 101,000. It follows that the shortfall in supply of doctorally qualified staff to higher education will amount to over 20,000 by 1970. Figure 2 represents all this translated back into total supply and demand for doctorates, i.e. allowing for the assumption that only 60 per cent of all Ph.Ds. are employed in higher education.

103. Berelson arrives at much more optimistic conclusions in the following way. He starts with an estimated student/teacher ratio of 15 : 1. This agrees with the Office of Education's estimate of a "full-time equivalent of 232,000 faculty and administrative staff" for 3.5 million students. Berelson then assumes a 4 per cent annual replacement ratio, allows for deterioration of the student staff ratio to 16 : 1 and computes a cumulative need of fewer than 200,000. He actually suggests a figure of 180,000. This calculation appears to be wrong. If we begin with 232,000 and end with 375,000 (one sixteenth of six million) then, allowing for wastage of 4 per cent per annum, the total replacement over the ten years must be the difference between these two figures, 143,000, plus the wastage of 121,400 ($\frac{44}{100} \times 10 \times 303{,}500$), that is 264,400 and not, as Berelson asserts, 180,000.

1. A.B.D. = all but disertation.

Figure 2. CUMULATIVE NEED FOR OUTPUT OF DOCTORS' DEGREES



Source : U.S. Office of Education *"Ten-Year Objectives in Education, Higher Education. Staffing and Physical Facilities, 1960-61 through 1969-70".*

104. Thus the likelihood is that either quality or quantity of teaching in higher education is severely threatened. If a seriously unsatisfactory situation is to be avoided drastic measures are required. The Office of Education estimated, for example, that the annual expenditure on graduate fellowships which amounted to $ 35 million in 1960 would have to be at least doubled. The Office also believes that a doubling of average faculty salaries will be necessary if the required number and quality of staff is to be attracted, and it appears that the total expenditure on professional staff salaries will have to be multiplied by more than three times from the 1957-58 figure to the figure of approximately $ 6 billion if the total projected for teaching and research staff of 402,000 is to be attracted to the universities and colleges.

105. Two other points on the problem of numbers must be made. First, it should be noted that, if annual flows are considered rather than cumulated supply, the projections indicate that by 1968 the flow of Ph.Ds.

will be 17,400 which, assuming 60 per cent go into teaching in higher education, will ensure that the following year's recruits are composed of 36 per cent Ph.Ds. In other words, the problem is one of the shorter rather than the longer run — a problem of expanding the graduate schools quickly to meet the needs for qualified staff as they arise. Some sort of crash programme is indicated.

106. Secondly, it should be noted that the foregoing analysis is global and therefore assumes that the disciplinary "mix" will be exactly matched to the demand in 1970. But, as the authors of the Office of Education Report point out: "there is ample evidence that current patterns of doctorate production do not coincide with the Nation's needs for persons with doctor's degrees".

107. The N.E.A. study puts great emphasis on this aspect of the supply problem. It is pointed out, for example, that in mathematics while 24.2 per cent of the new recruits held doctorates in 1953-54, the proportion fell to 19.7 per cent by 1959-60 — the fall demonstrating a failure of the supply of mathematical doctorates to keep pace with rising demand. The demand for and attraction of posts outside the educational system is rising and affects particularly the task of recruiting teachers in the sciences. Among Chemistry doctorates of 1958-59 and 1959-60 only 14.6 per cent became college teachers in the year following their graduation. The figure for physics is 18.7 per cent. (To these percentages must be added 4.7 and 7.8 respectively to take account of those who were college teachers before obtaining the doctorate.) In general, the capacity of the higher educational system to hold those whom it trains to the doctorate level varies from over 90 per cent in English to less than 20 per cent in chemistry with the humanities tending towards the top and the sciences towards the bottom.

108. Thus, despite the enormous shift in the centre of gravity of graduate students which took place in the period before 1930, (the proportion of graduate students in the physical and biological sciences rose from 28.7 per cent in 1897 to 49.1 percent in 1957) the subsequent rise in total demand for scientists and technologists has been greater and, in the resulting price competition, many universities and colleges have had to choose between insufficient numbers and inferior quality.

8. THE QUALITY OF TEACHING

109. Our judgment on the numbers problem is also in part a judgment on the question of quality. We have formed the impression that general standards of teaching in high schools, post-secondary institutions and undergraduate colleges are in decline, but that standards at the top of the institutional hierarchy are rising. The outlook for the immediate future seems to indicate a strengthening of these tendencies, though with some countervailing force from the movement towards quality in high-school science teaching.

110. In general, quality is worsening through shortage of qualified teachers and growing enrolments. In the developing competition for faculty, difficulties will be felt most by the weaker institutions. Our

questioning of academic persons across the country left us with the impression that the nationally known graduate schools, with close access to the source of supply in their own students, look forward with the least dismay, while the smaller schools, and more definitely the liberal arts colleges, seem likely to be the hardest hit, especially in the competition for scientists.

111. The N.E.A. study[1] shows that, out of 1,085 colleges and universities, 519 had unfilled vacancies in 1959-60 or 1960-61 and 826 foresaw a worsening situation in the future. The shortage fields most frequently mentioned were the physical sciences (200 institutions), mathematics (142 institutions) and engineering (81 institutions). Of the 530 junior colleges, 432 reported shortages in one or more fields and here again mathematics and the physical sciences were the subjects of greatest difficulty in the search for qualified people.

112. In consequence, a picture emerges of a lengthening hierarchy of quality of faculty which parallels the hierarchy of student quality and institutional prestige. If the quality of faculty is measured by the proportion possessing doctoral degrees the hierarchy is represented by the total distribution for 1953-54 shown in column 1 of Table 11, and the lengthening of the hierarchy by the distribution in 1959-60 and 1960-61 of new teachers with doctorates in columns 2 and 3. The recent history of the private liberal arts colleges is especially noteworthy as indicating a fall in the relative quality of a type of institution which has traditionally contributed greatly to the best of American graduates and which continues to attract relatively high quality students.

113. We do not, of course, wish to suggest that the proportion of faculty with Ph.Ds. is a pure measure of the quality of a university or college as a teaching institution[2]. We should also draw attention to the evidence produced in Orlans' study for the Brookings Institution that about six out of every ten of those who had taught in his sample of 36 institutions of high or good repute since 1956 or 1957 had observed either a "slight" or "marked" improvement in faculty quality. This evidence, however, is not inconsistent with our general impression that the overall decline of faculty quality, both present and threatened, is accompanied by an increasing concentration of talent among the leading institutions.

114. Nevertheless the problem is not confined to the less illustrious institutions. The basic fact is that research in general, and federal support for research in particular, is at best an equivocal friend to teaching and often an outright enemy. This underlying feature of the rise of science and technology is a recurring theme of this report and in our view perhaps the most important strategic issue in the relation between the federal government and higher education.

115. The conflict between research and teaching manifests itself in diverse ways. First, as will be seen below (Section 9), research funds tend to

1. National Education Association, *Teacher Supply and Demand in Universities, Colleges and Junior Colleges 1959-60 and 1960-61*. Research Report 1961-R12. Washington, 1961.

2. For example in fast developing branches of the sciences there is the problem of 'obsolescence' of the older teacher irrespective of his formal qualifications.

go to university graduate schools rather than undergraduate liberal arts colleges, where teaching is relatively highly valued and emphasized. Second, because this is so, ambitious and energetic scholars tend to seek careers at graduate rather than undergraduate institutions in order to find teaching loads, more money, more prestige and better opportunities for academic recognition and promotion. Third, it follows that a process of attenuation takes place between the research frontier and the undergraduate classroom, with the most talented people tending to be on the frontier and their more pedestrian colleagues in the undergraduate classroom.

116. In short, the rewards attaching to research in modern America are paid for partly at the expense of undergraduate teaching. Federal funds accentuate this tendency. Direct Federal support of the teacher as teacher, could contribute to the redress of a desirable balance ?

117. Another aspect of the same general phenomenon is the removal through research of a considerable volume of teaching talent. This affects graduate as well as undergraduate teaching. A notable manifestation of this is the absentee professor. The rise of the international research community has made the conspicuous absence of illustrious people a characteristic feature of many campuses. It is, in part, an inevitable consequence of the research age and the involvement of academics in government. In part it is a consequence of the increased scale of research which makes senior men neither researchers nor teachers but administrators. In part too it is a feature of the price offered by inspiring institutions in exchange for the possession of famous names on their faculty lists. But whatever the reason, the effect on graduate teaching is a bad one : courses are disrupted and students seek teachers who are not there.

118. At a lower level the removal phenomenon appears in the shape of the research associate. As Orlans concludes : "Federal research programs

TABLE 11. TEACHERS POSSESSING DOCTORAL DEGREES IN DIFFERENT TYPES OF INSTITUTIONS

In percentages.

TYPE OF INSTITUTION	TOTAL FULL-TIME STAFF WITH DOCTORATES 1953-1954	NEW STAFF WITH DOCTORATES	
		1959-60	1960-61
Private Universities	51.9	36.2	35.9
State Universities	47.6	29.3	29.7
Municipal Universities	44.3	30.5	29.9
Land Grant Colleges	42.5	30.1	29.8
Private Colleges (1000 + students)	38.0	21.3	21.4
» » (500-999 students)	35.9	20.4	17.6
State Colleges	32.5	20.9	22.6
Private Colleges (under 500 students)	31.3	18.7	17.0
Teachers' Colleges	29.9	15.9	15.9
All Institutions	40.5	25.9	25.8

have brought to many university campuses a large number of post-doctoral research scientists relatively divorced from normal departmental educational functions. Their involvement in teaching has been limited by the requirements and administrative restraints of the programs, faculty opposition, and their unsatisfactory academic status (not to mention their frequent lack of interest in teaching). Explicit encouragement by the government, more favourable employment policies, and more imaginative educational methods can return to the educational community some of the talent which research programs have removed from it".

119. At an even lower level removal is encouraged by the distribution of support to graduate students (who form an indispensable component of the teaching force on many campuses). The general effect of research fellowships in the sciences is to channel the most talented people away from teaching and to leave the teaching assistantships to the lesser lights. This undesirable consequence of governmental and charitable support for research could and should be modified by requiring some teaching service from research fellows.

120. All this represents the shadow cast over teaching by research. But a shaft of light also emanates from research into the teaching process itself. In the past five years there has been a strong movement towards raising the quality of teaching in mathematics, physics and chemistry, and in English and other languages in high schools, which was frequently reflected in the opinions about student quality of the university teachers to whom we spoke. An enthusiastic appraisal of the success of the movement has recently been written by the President of the California Institute of Technology[1]. "There is a movement growing rapidly in the better high schools of the country, (at least 1,000 of them) to give more attention to college preparatory work for their academically gifted students. It goes without saying that the thousands of teachers who have prepared themselves to give advanced placement courses find themselves also in a much better position to give better instruction in the regular high-school courses".

121. The movement began in the 1950's at the same time as the increasing recognition that college preparation was suffering from both the waning supply and declining quality of science teachers in high schools. An early stimulus to the movement came from the *Advanced Placement Program* of the *College Entrance Examination Board*. In 1953, only 18 high schools offered such courses : by 1961 the number was 1,126. Meanwhile, the quality of both teachers and their methods has been raised to a considerable degree. In 1956, the National Science Foundation gave financial support to the Physical Science Study Committee, organized by Professor Zacharias and others at M.I.T., in order to improve the content of high school physics courses. The Committee prepared a new one-year syllabus with new textbooks. They developed a new and standardised apparatus for laboratory experiments and produced a series of high-quality documentary films. A similar chemistry study course has been developed under the leadership of Professor J. Arthur Campbell of Harvey Mudd College in California.

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1. Lee A. DuBridge, "Why the New Freshmen Keep us Hopping", *Think*, April 1962.

122. These new methods are being introduced into the high schools through the re-training of science teachers in training courses financed by the National Science Foundation throughout the country. So far about half of the 180,000 science and mathematics teachers in the United States have participated in courses in at least one summer institute, academic-year institute, or in-service institute supported by funds from the National Science Foundation. But very much remains to be done to strengthen the subject matter competence of secondary school science and mathematics teachers in the United States. To us, the significance of this movement lies in its indication of a neglected direction of federal policy.

9. THE QUALITY-HIERARCHY AND FEDERAL FUNDS

123. We have referred at several points to the fact of concentration of quality and prestige among a few great national universities. We have also put forward the opinion that the present and future course of expansion will lengthen the hierarchy of institutional prestige but will not destroy it. In this section we shall look at the impact of expansion on the nature of the institutional hierarchy and, secondly, examine the influence of the pattern of distribution of federal support.

124. A mesure of concentration is provided by Table 12 which shows the institutional source of Ph. D. output for the academic year 1957-58. Doctorates were granted in 1957-58 by 175 institutions, but 6 institutions gave a quarter of them and two institutions (Columbia and Harvard) gave a tenth of them. This indicates a heavy concentration of advanced work and a small institutional basis for the production of the nation's top-level manpower. Hence the recurrent theme in public and official discussion that the institutional base should be broadened, and the expression of this feeling in the congressional instruction to the newly-founded National Science Foundation in 1950 "to strengthen basic research and education in the sciences... throughout the United States... and to avoid undue concentration of such research and education", or in the often-repeated plea for X more universities of the quality of Harvard, Chicago and M.I.T.

125. But two points must be noted immediately. The first, which is clear from Table 12, is that, within the tendency towards Ph. D. concentration, the physical and biological sciences are the least contained of all the disciplines. Second, the historical record shows that the trend in this century has been toward dispersal. As far as master's degree work is concerned the dispersal is almost complete : it leaves out only the junior colleges and a (possibly declining) breed of liberal arts colleges. In the production of Ph. D.'s the early monopoly of the great national private universities of Harvard, Columbia, Chicago, Yale and Johns Hopkins has been modified to a rough equivalent of about twenty institutions, nearly half of which are publicly controlled, and immediately below these are another fifteen or twenty state and regional institutions, mostly public, which are growing faster than the older establishments.

126. Another aspect of the trend towards decentralization is the relative decline of private as against public institutions. In 1900 the

former produced 93 per cent of the Ph.D.'s ; in 1958 the figure had fallen to 72 per cent. Thus to take a few examples, Berelson[1] has used Office of Education figures to calculate the relative growth in production of doctorates of the top 35 producers between 1947-48 and 1957-58. The three

TABLE 12. CONCENTRATION OF PH.D. PRODUCTION 1957-58 BY INSTITUTIONS AND FIELD OF STUDY

FIELD OF STUDY (1)	NUMBER OF INSTITUTIONS CONFERRING PH.D.'s		
	10 %	25 %	100 %
Agriculture	1	3	27
Biological	1	4	99
Business & Commerce	1	2	23
Education	1	3	94
Engineering	1	3	60
English & Journalism	2	5	61
Fine & Applied Arts	1	3	34
Foreign Language & Literature	2	4	43
Health Professions	1	3	31
Maths & Statistics	2	4	60
Philosophy	1	3	34
Physical Sciences	2	6	100
Psychology	2	6	73
Religion	1	3	39
Social Sciences	2	4	82
All Degrees	2	6	175

1. List includes only fields with more than 100 Ph.Ds. awarded in 1957-58.
Source : Office of Education, *Earned Degrees conferred by Higher Educational Institutions, 1957-58.*

fastest growing were all public institutions : Indiana (510 per cent), Michigan State (505 per cent), Washington (Seattle) (500 per cent). The three slowest growing were all private : Harvard (112 per cent), Northwestern (69 per cent), and Cal. Tech. (61 per cent). Berelson estimates that by 1970 the private universities will be awarding not many more than two out of every five doctorates in the country.

127. On the other hand it must be re-asserted that the pyramid of academic fame is one of impressive stability. We referred, in Section 3, to the 1925 and 1957 studies of opinion among departmental chairman. The pyramid rises on an ever broader popular base, but the leading institutions retain their relative place with but few exceptions. Moreover the shape of the pyramid is stable, for it is still true, as it was before the first World War, that a quarter of the doctoral institutions give three-quarters of the Ph. D.'s.

128. Doctoral output and the opinions of departmental chairmen are not the only criteria of institutional quality. The hierarchy is also identifiable in terms of faculty and student quality. In Orlans' study three kinds of institutions are identified. Group I comprises the 25 institutions which

1. *Op. cit.*

received $4 million or more in federal funds for the academic year 1957-58. Group II is made up of the 54 institutions which received $0.5 to $1.9 million in that year. Group III are good liberal arts colleges. Orlans studied 12 institutions from each of these categories. He summarises his results concerning the distribution of faculty and student quality among them as follows :

"At the undergraduate level, the rank order of mean student quality at our institutions was found to be :

1. Group III colleges
2. Group I, private universities
3. Group II, private universities
4. Group I, public universities
5. Group II, public universities.

"At the graduate level, the same sequence prevailed (minus, of course, Group III colleges) ; but the gap between students at different groups of institutions was noticeably reduced.

"Faculty in Group I are clearly superior to those in Group II. We are not inclined to extend this ranking to faculty at Group III, because of the thinness of the data embracing both university and college faculty, the different functions of the two faculties, and the uncertainty as to precisely which university population is represented — the college of liberal arts and sciences ? The professional schools as well ? What about affiliated research institutes ? Nor have we attempted to rank the faculty in public and private institutions within Groups I and II, because of the statistical hazards of doing so with the data in hand ; however, for whatever value a guess may have in such a treacherous business, the sequence of overall faculty quality, with notable exceptions at individual institutions, might well be :

1. Group I, private universities
2. Group I, public universities
3. Group II, public universities
4. Group II, private universities.

"It should also be observed that the quality of faculty and students at Group III varies quite sharply between those at a select group of six schools nationally recognized for their high educational (and in two instances, at any rate, social) standards, and another six which, while good, serious institutions above the average for independent liberal arts colleges, do not reach this level of achievement. Faculty and students at the six best schools (and there are not more than a dozen or two in the nation to match them) are responsible for most of the honors and distinctions recorded in preceding tables".

129. From all this we draw four inferences for the next decade. First, while the flow of undergraduates into graduate schools is increasingly from the undergraduate divisions of universities rather than from private liberal arts colleges, the average quality of the latter gives them a place in the scheme of doctoral production which can rightfully claim attention in any consideration of the distribution of federal funds. Second, America must rely on the long-established high-quality institutions whether private

134. This question has four aspects :

1. The scope of the financial role of the federal government. If, as we think, the question of research support should, in principal be separated from the question of aid to teaching in higher education, then those programmes which are designed to spread the net for talent and to help the poorer states would be seen more clearly as contributing towards the building of a strong popular and national system of national education ;
2. The support of the major research centres ;
3. The division of research funds between doctoral institutions and the rest ;
4. The division within doctoral institutions between the older elite universities and the new-comers to doctoral production.

These last three points are dealt with by Orlans.

135. Orlans is satisfied that the concentration of money in the research centres was justified by contemporaneous circumstances and should continue. This seems to us to be in the national interest, though his reservations concerning the necessity for management of a research centre by a single institution also deserve consideration.

TABLE 13. CONCENTRATION OF FEDERAL FUNDS AT EDUCATIONAL INSTITUTIONS 1948, 1954 & 1958

	ACADEMIC YEAR					
	1947-48		1953-54		1957-58	
	MILLIONS	PER-CENT	MILLIONS	PER-CENT	MILLIONS	PER-CENT
Total Federal Income[1]	528.0	100.0	419.5	100.0	712.4	100.0
Veteran'sTuition and Fees	365.1	69.1	44.4	10.6	5.1	0.7
Land Grant Institutions	43.2	8.2	50.6	12.0	83.9	11.8
Research and Development[2]	95.3	18.0	282.4	67.3	534.4	75.0
Other	24.5	4.6	42.2	10.1	89.0	12.5
Top 10 Institutions	118.5	22.4	203.5	48.5	368.9	51.8
Next 10 Institutions	49.2	9.3	40.4	9.6	68.8	9.7
All other Institutions	360.2	68.3	175.6	41.9	274.7	38.5
No. of colleges and universities reporting	1,741		1,871		1,940	

1. Income for educational and general purposes received from the federal government as reported to the U.S. Office of Education.
2. Income for research at land-grant agricultural experimental stations reported in line above.

Source : H. Orlans, *The Effect of Federal Programs on Higher Education.* Brookings Institution 1962. Table 28, p. 165.

136. On the other hand, Orlans points to a definite weakness in the concentration of research funds at doctoral institutions compared with liberal arts colleges. We have seen that, while occupying a unique place in American higher education in terms of their history, their devotion to teaching and the quality of their undergraduates, the future of the liberal arts colleges is less bright. They face a stiffly competitive market for private gifts ; they cannot afford to allow too much of a disparity to

develop between their fees and those of public institutions; they are already relatively weak in science; they will be especially hard hit by competition in the coming decade for highly qualified staff, especially scientists who can go to the universities and to research laboratories having lower teaching loads, greater research opportunities and therefore higher career prospects. Some redistribution of federal research money in favour of the better liberal arts colleges has accordingly much to recommend it. It would purchase both science and prospective scientists more cheaply at the margin. The N.S.F. matching grants for scientific equipment to be used in undergraduate teaching and their grants for the purpose of allowing undergraduate science majors to participate in research were mentioned to us with enthusiasm. However, it seems that the scientific programme of some liberal arts colleges could be quickly enriched by a vigorous programme of small research grants to members of their science faculties.

137. Finally, there is the problem of the elite graduate schools. Here Orlans is not able to offer a simple answer and it is highly doubtful whether there is one. Clearly, from the point of view of any particular programme, the money should be placed where it is most likely to produce the desired result. This means, by and large, that the money will follow quality and, since the latter is concentrated in a few institutions, so must be the former. But it is more complex than that. Standards can fall in the most prestigeful of institutions and rise in unexpected quarters. And obviously the greater the fund, the greater the spread and the less that can be expected from the marginal dollar.

138. One of the basic issues is the inherent conflict between more science and more scientists. Grants designed to foster the one do not necessarily foster the other. Thus there is evidence that the enormous research grants enjoyed by the foremost institutions reduce the quality of their undergraduate — and probably too their graduate — teaching by taking away the time of high-quality faculty and by reducing the prestige of the teaching function itself. On the other hand, there is also a widespread impression that the second-line institutions tend to expand their graduate output to some extent at the cost of producing mindless and ritualistic research — what Sir Eric Ashby has called "crawling along the frontiers of knowledge with a hand lens". In this connection there are two points we would make. First, the establishment of a larger number of academic centres of science of the first rank must depend upon *more* rather than redistributed funds, and more rather than re-distributed talent. More money can, given the will, be found. More talent must depend upon the intrinsically slower process of reducing educational wastage among the potentially highly talented, and educating that talent in existing high-quality institutions. Secondly, we again emphasise that teaching and research are not identical functions. The traditional training of doctoral candidates is based on the assumption that teaching is a by-product of research or, in career terms, that teaching is the price of research and that the young man will do well to avoid payment if he can. It may well be that the present balance of rewards between teaching and research is detrimental to the higher educational system as a whole. Low teaching salaries and the emphasis on the doctoral thesis both symbolise a question-

able distribution of rewards between competing functions in universities and colleges. And the federal effort, heavily weighted towards research support as it is, contributes to the inbalance.

139. Another basic issue is the conflict between public and private institutions. It is a matter of history that the older elite centres of research were private, and Orlans expresses a characteristically American sentiment in calling for support to those public institutions which have shown themselves to be in the second fifteen. Could San Diego become a publicly controlled Harvard? Certainly the California master plan offers, and Berkeley already demonstrates, the possibility of establishing the highest quality on a massive popular base. There can surely be no case against federal encouragement to state institutions capable of matching the quality of Yale or Princeton, but again, we would emphasise, *not* at the expense of the private institutions. Orlans stresses the many advantages of private universities in a free enterprise society (their prestige, wealthy patrons and entrenched positions in relation to federal research funds and, on the other hand, the difficulties looming up for the state universities in the shape of increasing enrolments and reluctant state treasurers). But there is need for caution here. Private institutions can also falter. For example, according to the studies referred to in Section 3, the only university to lose its place in the top 14 graduate schools between 1925 and 1957 was a private institution -- Johns Hopkins was replaced by a public institution — U.C.L.A. Of the 14 leaders in 1925, three fell substantially and three rose ; two of the former were private and all of the latter were public. The tide is by no means all one way as a comparison of the post-war fortunes of private Chicago and public Berkeley could easily be made to demonstrate.

140. While not dissenting from Orlans' plan on behalf of the state university, and while fully endorsing his principle of support to the kind of institution which "stan[illegible] like a monadnock on the plains, representing the best that higher education has to offer to the population of a vast region", we would urge rather more emphasis on the latter than on the former and even more emphasis on the overriding national character of graduate schools and their problems. Private or public institutions seem to us to converge rather than to differentiate. The broad aim of policy must be to encourage a wide geographical spread of the highest possible quality.

10. EDUCATIONAL HELP TO UNDERDEVELOPED COUNTRIES

141. Perhaps the most serious implications of the development of science and technology in U.S.A. are those which turn on the successful diffusion of scientific culture to the underdeveloped areas of the world. This is a problem of enormous proportions involving not only the growing participation of thousands of Americans in international programmes of educational exchange, but ultimately the whole complex of American foreign relations — political, economic, cultural and military.

142. Men, resources and ideas flow continuously across the borders of the United States. Governmental and private agencies take part, on a

considerable scale, in projects aimed at stimulating technological advance and economic growth in Asia, Africa and Latin America. The O.E.C.D. Washington Conference, in October 1961, clearly demonstrated, and repeatedly confirmed in the discussion, that a systematic evaluation of these and similar efforts by other O.E.C.D. countries would constitute a large-scale and worth-while exercise. Studies like that of the Ashby Commission in Nigeria are necessary to a national educational aid programme but are too seldom available. Surveys of the manpower needs and educational resources of the under-developed countries have an obvious claim on the seven million dollar research fund held by A.I.D. These questions however lie outside the scope of the present review. We must confine our attention to the education and training of foreign students within the borders of the U.S.A.

143. In 1961-62, there were over 60,000 foreign students in the United States. In 1958-59 foreign students constituted 1.7 per cent of all students in American higher education, making up 1.3 per cent of the undergraduates, 5.3 per cent of the graduates and 2.3 per cent of those reading for professional degrees. Since the end of the second world war the number of foreign students has been increasing rapidly, as may be seen from Table 14. The numbers tripled between 1947 and 1960.

144. Most of the students come from the under-developed world, especially the Far East which contributes over a third ; but over a quarter come from Canada and Europe, and less than 5 per cent from Africa, though its latter proportion is rising rapidly. Table 15 shows the distribution of foreign students by country of origin.

145. Education and training of foreigners in the U.S.A. is not confined to students. The Institute of International Education surveyed the 69,683 foreigners visiting U.S.A. for educational purposes in 1960. Of the total, 53,107 or 76 per cent were students. Of the remainder, 9,935 were interns and residents affiliated to U.S. hospitals, 3,636 were scholars, lecturers or advanced researchers appointed to U.S. faculties, and 3,005 were trainees with U.S. business and industrial firms.

146. Of the students, about half study science, engineering and mathematics. In 1961-62, the largest group (22 per cent) was in engineering, with 19 per cent in the humanities, 16 per cent in the natural and physical sciences, and 14 per cent in the social sciences.

147. On average the foreign student stays in the U.S.A. for 2 years. He is usually supported by his family, savings or part-time employment. Only ten per cent come on U.S. government grants, and these are largely graduate students on one-year courses. It appears, from a recent small sample study by the Stanford Research Institute[1], that three-quarters of the students came from big cities in their countries of origin, half of them had fathers who had been educated to the level of the American bachelors' degree and a third are financially supported by parents or relations.

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1. Stanford Research Institute, *A Preliminary Study of the Goals and Problems of the Foreign Student in the United States.* Prepared for U.S. Department of State, Washington, D.C. December, 1961.

TABLE 14. FOREIGN STUDENTS[1] IN INSTITUTIONS OF HIGHER LEARNING IN THE UNITED STATES

ACADEMIC YEARS 1947-48 THROUGH 1960-61

YEAR	NUMBER OF STUDENTS	INDEX
1947-48	17,218	50
1948-49	25,464	74
1949-50	26,433	77
1950-51	29,813	87
1951-52	30,462	89
1952-53	33,675	98
1953-54	33,833	99
1954-55[2]	34,232[2]	100[2]
1955-56	36,494	107
1956-57	40,666	119
1957-58	43,391	127
1958-59	47,245	138
1959-60	48,486	142
1960-61	53,107	155

1. "A foreign student... is a citizen of a country other than the United States who is studying or training in an institution of higher education in the United States ; and who plans to return to his home country when his studies are completed. The term does not include displaced persons, immigrants, persons who have taken out first citizenship papers, or foreign citizens studying in the United States below the college level." *Education for One World*, May 1954, p. 4.

2. 1954-55 = 100.

Source : A Fact Book on Higher Education, American Council on Education, 1961, p. 120.

148. Our discussions elicited many doubts and difficulties among the universities and colleges concerning the foreign-student programmes. They may be resolved into three questions :

1. Do students come in the right numbers ?
2. Are they the right students ?
3. Do they receive the right education ?

149. On the first question our inclination is to agree with those who hold that the overall size of the U.S. foreign student intake is insufficient. Prominent among the proponents of this view is Mr. Philip Coombs who recently, as Assistant Secretary of State for Educational and Cultural Affairs, addressed himself to the problems[1]. After remarking on the past and present contribution of immigrants to American scholarship and the striking fact that there are more Americans at European universities than there are European students on American campuses, Mr. Coombs concluded that : "looked at in historical perspective, international educational exchange has been a two-way affair from which the United States has probably gained far more thus far than it has given". He went on to point out that the number of foreign students in the United States "represents only 1.5 per cent of our total university and college enrollments. By contrast, in 1959 foreign students represented 10.7 per cent of total higher education enrollments in the United Kingdom ; 7.7 per cent in

1. Philip H. Coombs, *Let's Talk Sense About Foreign Students*. An address to the 14th Annual Meeting of the Greater New York Council for Foreign Students, December 4th, 1961.

France ; 8.8 per cent in West Germany and more than 30 per cent each in Austria and Switzerland. Despite the much smaller higher educational establishment of the United Kingdom, there were nearly as many foreign

TABLE 15. FOREIGN STUDENTS IN INSTITUTIONS OF HIGHER LEARNING IN THE UNITED STATES, BY COUNTRY[1]

ACADEMIC YEAR 1960-61

COUNTRY	NUMBER OF STUDENTS	PERCENT OF TOTAL
Canada	6,058	11.4
China[2]	5,304	10.0
India	4,835	9.1
Iran	2,880	5.4
Japan	2,434	4 6
Korea	2.310	4.3
Philippines	1,727	3.3
Mexico	1,490	2.8
Venuzuela	1,207	2.3
Greece	1,200	2.3
United Kingdom	1,069	2.0
Thailand	966	1.8
Jamaica	930	1.8
Israel	877	1.7
Germany	868	1.6
Turkey	867	1.6
Egypt	840	1.6
Cuba	837	1.6
Other	16,408	30.9

1. This table includes only countries with 800 or more students in the U.S. All told, 143 foreign countries and territories are represented.
2. Students from Taiwan, Hong Kong and Macao, and the mainland.
Source : Fact Book on Higher Education, p. 225.

students there last year as in the United States... For its size, Western Europe handles a much larger share of the total foreign student supply than the United States". The argument for an increase therefore seems strong. It is supported in the case of the under-developed countries by the general economic principle of comparative advantages, i.e. the relatively cheap cost of education in advanced countries which may be illustrated by Professor Arthur Lewis's much quoted observation that while universal primary education would cost 4 per cent of G.N.P. in Nigeria, it costs only 1 per cent of G.N.P. in an advanced country.

150. On the other hand, we are aware of the great importance which is rightly attached to efforts, such as those of the consortium of U.S. universities at the Indian Institute of Technology in Benares, which are directed towards stimulating indigenous educational development with its multiplier effects for the educational, economic and cultural systems of the country concerned. It would be foolish to minimise the usefulness of this kind of effort in the attainment of the goals of self-sustaining economic growth and social development. We are also impressed by the argument that some other O.E.C.D. countries such as France and the United Kingdom are better qualified, from experience and established facilities, to develop student programmes for many parts of the under-developed world.

This line of argument emphasises the wisdom of a division of labour among O.E.C.D. countries and also the possible development of co-operative ventures perhaps through the O.E.C.D. organisation itself. It also suggests the possibility of indirect support by the United States of the foreign-student programmes of other advanced countries.

151. But these arguments do not, in our view, undermine the case for an expansion of the United States domestic programme. The greatest possible efforts, direct and indirect, at home and abroad, are urgently required. There can be no question of the need for quantity. What is important is to ensure quality, and this aspect of the problem raises our second and third questions.

152. The under-developed world is characteristically rural, poor and ill-educated. The Stanford Research Institute statistics on the socio-economic background of foreign students are an indication that considerable social and economic selection is involved in the processes which lie behind arrival on the American campus. Sociological study of these processes would throw light on the contribution which foreign student exchange programmes make to the development of equality of educational opportunity in the under-developed countries. More immediately, it would appear that some financial obstacles could be reduced by an extension of the length of scholarships and other awards by both the federal government and private agencies, especially in the case of undergraduates.

153. Another more immediate concern is with academic selection among available candidates. The need for a development of valid and recognised attainment and aptitude tests for selection purposes is a strong priority and in general, as Mr. Coombs has put it, "no single thing would do more to improve the quality of foreign student programmes in the United States than the establishment of a competent system of guidance and selection overseas which would serve both the foreign student and the American institution"[1]. A cooperative effort here, not only between receiving campuses, but also between receiving countries, has great potential usefulness.

154. The third question is the most difficult to answer. It is a widespread adverse comment on the courses followed by students from the under-developed world in Western universities that their choices are not congruent with the economic needs of their home countries. Too many study law, and too few study agricultural technology. Inappropriate choices of this kind are not surprising when account is taken of the selection process, which is not oriented specifically to the manpower needs of a policy for economic growth. Few would suggest that this should be the sole criterion, but as a guiding principle of Federal Government support of foreign students it has much to recommend it. Rational policy formation on this issue must depend upon the systematic educational and manpower surveys which we have advocated and also upon the systematic follow-up of the experience, especially the occupational experience, of students returned from study in the United States.

1. See page 55, note 1.

155. Whether or not the appropriate disciplinary balance is being struck there can be little doubt that many problems arise from the fact that American courses are designed for American students. They assume, in applied science for example, the availability of the material culture of an advanced industrial society ; they are taught in a version of the English language and according to the customs of American academic life. During our visits to a variety of campuses we asked what special prevision was offered for foreign students. One respondant expressed surprise at the question and asserted the principle that the foreign student should be treated in exactly the same way as a home student. In-so-far as this attitude reflects determination not to offer debased standards to foreigners it is wholly admirable. But in all other respects it runs counter to rational principles of teaching and learning which must take account of the social and psychological context of the student. We gained the impression that there is growing appreciation of the need for appraisal of academic programmes for foreign students from this point of view. Here again there seems to be a need for co-operative effort on the part of the universities with large foreign-student programmes, entrepreneured perhaps by the Federal Government, the Institution of International Education and other private agencies. Linked to this is the possibility of working out some sort of specialisation among campuses by country of origin of foreign students. Certainly the widespread tendency among the smaller institutions to gather what Mr. Coombs has called a "United Nations Noah's Ark" is more of an illusory cosmopolitanism for provincials than a contribution to the developmental needs of the poorer countries.

156. Finally we may mention that aspect of the foreign students' education which derives from informal rather than formal instruction. The Stanford Research Institutes' study, which was conducted towards the end of an academic year when the problems of initial orientation, course choices, English competence, etc., are likely to have been solved, showed that the two outstanding items of complaint related to inadequate opportunities to get to know American families and to tour America.

PART II

SUMMARY OF THE CONFRONTATION MEETING

SUMMARY OF THE CONFRONTATION MEETING

The confrontation meeting for the country review of the United States was held in Paris on Wednesday, January 30th, 1963, at a regular meeting of the O.E.C.D.'s Committee for Scientific and Technical Personnel under the chairmanship of Mr. Henning Friis (Denmark).

The members of the United States delegation were :

The Hon. Ivan A. Nestingen
Under-Secretary, Department of Health, Education and Welfare,
Washington, D.C.

Dr. George W. Beadle
Chancellor, University of Chicago,
Chicago, Illinois

Dr. Bowen C. Dees
Assistant Director, National Science Foundation,
Washington, D.C.

Dr. Julian W. Hill
Executive Secretary, Committee on Educational Aid
E.I. du Pont de Nemours and Company
Wilmington, Delaware

Dr. Harold W. Stoke
President, Queens College,
Flushing, New York

Dr. Ralph W. Tyler
Director, Center for Advanced Study in Behavioral Sciences
Stanford, California

The examiners were :

Sir John Cockcroft
Master of Churchill College
University of Cambridge

Prof. Ingvar Svennilson
The Institute for Social Sciences
Stockholm University

Dr. A. H. Halsey
Head of Department of Social and Administrative Studies,
University of Oxford

In addition, the Committee had the assistance of the following distinguished guests who were invited to join their country's permanent delegate to the Committee to participate in the discussion :

France :

M. Jean Capelle
Directeur général de l'Organisation et des Programmes scolaires,
Ministère de l'Education nationale

M. Raymond Poignant
Maître des requêtes au Conseil d'Etat ;
Conseiller juridique
Délégué général à la Recherche scientifique et technique

Germany :

Dr. Friedrich Schneider
Generalsekretär des Wissenschaftsrats

United Kingdom :

Prof. H. Lionel Elvin
Director, Institute of Education
University of London

Sir Willis Jackson
Head of Department of Electrical Engineering
Imperial College of Science and Technology

Prof. Alan T. Peacock
Professor of Economics
University of York

I. INTRODUCTION — THE FRAMEWORK OF THE DISCUSSION

The United States has been outstandingly successful in the application of science to industrial processes and to the creation of consumer goods. It has transformed itself in a relatively short time from a predominantly agricultural country into the most productive and most diversified industrial state. Inevitably, other countries are looking at the United States as a possible model for their own future development. The latter aspect is particularly pertinent to the review of the United States. Both in their report[1] and in their opening statements at the confrontation meeting, the examiners emphasised the relevance of American experience for the other member countries of O.E.C.D.

Among the many factors that have contributed to America's economic growth, none has been more important than its bold initiative in the field of education. While most countries have as yet completed only the first stage of educational advance — the provision of universal elementary education — the United States has long recognized that universal secondary education is necessary in an advanced industrial society, and has now virtually completed this second stage. In fact, it is well into a third stage in which higher education will also become universal.

The necessity, or at least the desirability, of following much the same pattern will have to be considered — sooner rather than later — by European countries. An alternative model is, of course, available : the Soviet Union has also had considerable success in gearing its educational system to rapid industrial and technological development by centralised educational planning and the deliberate disposition of its young men and women in a neat hierarchy of educational institutions. In contrast, the American scene offers what Dr. Halsey described as an enormous, amorphous, untidy, collection of academic institutions competing with one another in the intellectual market for financial support, prestige, faculty, research achievement, and students[2]. The contrast between these two systems presents some dilemmas to educators and politicians in other countries who are concerned with the task of expanding educational opportunities and fostering economic growth.

The complexity and unruliness of the American scene also presents some dilemmas for those concerned with the future role of the Federal government in educational development. The examiners were impressed by the magnitude of the task facing the U.S. authorities but also, as Sir John

1. Cf. paras. 7 and 10.

2. Mr. McGeorge Bundy, the former dean of Harvard University, remarked in a speech to university administrators that "People who talk about the rigors of competition in business have never watched us in our efforts to land a big grant or a big professor or a big philanthropist. We have got to learn to be less cut-throat..."

In passing, it might be noted that the decline in the death rate and the lengthening of the span of productive years — which is being brought about by the greatly expanded medical research programme in the United States — is also an important economic and social factor. It is predicted that between 1960 and 1970 the life expectancy for men will be lengthened by three years (to 69 years) and that the population over 65 years of age will increase by 25 per cent (to 20 million). On the other hand, immigration, while not negligible, is not now a major factor in population growth. During the 1950's it averaged only 250,000 a year which represents an annual population increment of less than one-sixth of one per cent.

A second powerful force affecting higher education in the United States is the speed and manner in which the economy is changing. This change has many aspects but one of the most fundamental is the transformation of the United States from a predominantly agricultural to a highly industrial nation and the consequent movement of people from the farms to the cities.

In spite of the enormous population growth there has been a steady and quite rapid decline in rural population and farm employment with, of course, a corresponding rise in city population and industrial employment. The 1960 census showed that the rural population was nearly half-a-million less than it had been in 1950, while the urban population had increased 29 per cent during the ten years. This phenomenon is evident throughout the country — between 1950 and 1960 the urban population increased in each of the fifty states and now exceeds the rural population in 39 of them. Nationally, the proportion of the population classified as living in urban communities grew from 56 per cent in 1930 to 64 per cent in 1950 and to 70 per cent in 1960. This trend is still continuing.

Moreover the majority of workers who live in what the census-takers define as rural areas do not in fact work on farms. In 1930, more than one-fifth of the labour force was engaged in farming ; now the proportion is less than one in ten. What is even more significant is that the actual number engaged in farming (a little over six million) is less than 60 per cent of the number so engaged in 1930. This shift reflects profound economic and social changes which exert major pressures in the educational system.

	EMPLOYED CIVILIAN LABOUR FORCE	EMPLOYED FARM WORKERS	
	(MILLIONS)	(MILLIONS)	(PERCENTAGE)
1930	45.5	10.3	22.6 %
1940	47.5	9.5	20.0
1950	59.7	7.5	12.6
1960	66.7	5.7	8.6

One of the most important of these changes is in the kinds of jobs in which people are employed. Since 1955, the number of people engaged in professional, office and sales occupations in the U.S. has for the first time exceeded that in manual occupations. Similarly, the service occupations now exceed farming in their demand on the labour market. The proportion

Cockcroft said, by the cheerfulness and vigour with which they are tackling their problems.

On the basis of their report, the examiners posed a number of questions grouped under four general headings. These were neither intended, nor used, as an agenda for the confrontation session but merely as a rough framework for the discussion. The questions were :

Economic and technical forecastings :

1. The Examiners Report suggests a shortfall in the supply of scientists and engineers for the 1970s. What steps will be taken to meet this situation ?
2. In our Report we have strongly endorsed the view that the supply of teachers in higher education will be a crucial bottleneck. Is this true and if so what can be done about it ?

Individual educational experience :

3. A move towards improving the standard of science education in high schools has been remarked. How can this movement be enabled to gather strength more rapidly ?
4. We have argued that the proportion of undergraduates reading science and technology is too small. Is this a fair judgement and if so what can be done about it ?
5. The so-called "wastage rate" of 40 % among undergraduates might be held to be too high. Is this so, and if it is what can be done about it ?
6. Is the graduate scholarship programme of sufficient magnitude ?

Federal aid to education :

7. The Office of Education 10-year forecast estimates an enormous overall budget for higher education in 1970. What will be the sources of finance and how much can be expected to be contributed by the Federal government ?
8. We have been impressed by the California Master Plan and by the arguments for planning higher education on a state-wide or interstate basis. How far is this view held generally and how far can the Federal Government stimulate or facilitate such developments in the national interest ?
9. What should be the relationship between the national research institutes and the universities ?

The balance of intellectual life in American universities :

10. A case has been made for Federal Aid to higher education not so much through research but *directly to teaching*. Is it accepted and if so how can it be implemented ?
11. The effort to expand science is widely held to threaten the intellectual balance of the universities and particularly to reduce the vigour of the humanities. What is being done about this ?
12. In particular, the liberal arts college appears to us to be under great stress as a *relatively* declining institution. Should agencies give greater support to liberal arts colleges ?

2. BACKGROUND OF THE HIGHER EDUCATION PROBLEM

To open the discussion Dr. Stoke presented the following brief survey of some of the broad economic and social factors that underlie the problems of scientific and technical education in the United States. The charts are based on slides which Dr. Stoke used to illustrate his talk.

One of the most potent forces influencing the development of higher education in the United States is the enormous growth of its population. Not only the magnitude but the rapidity of this growth is having a telling effect on every phase of national life — economic, political, social and educational.

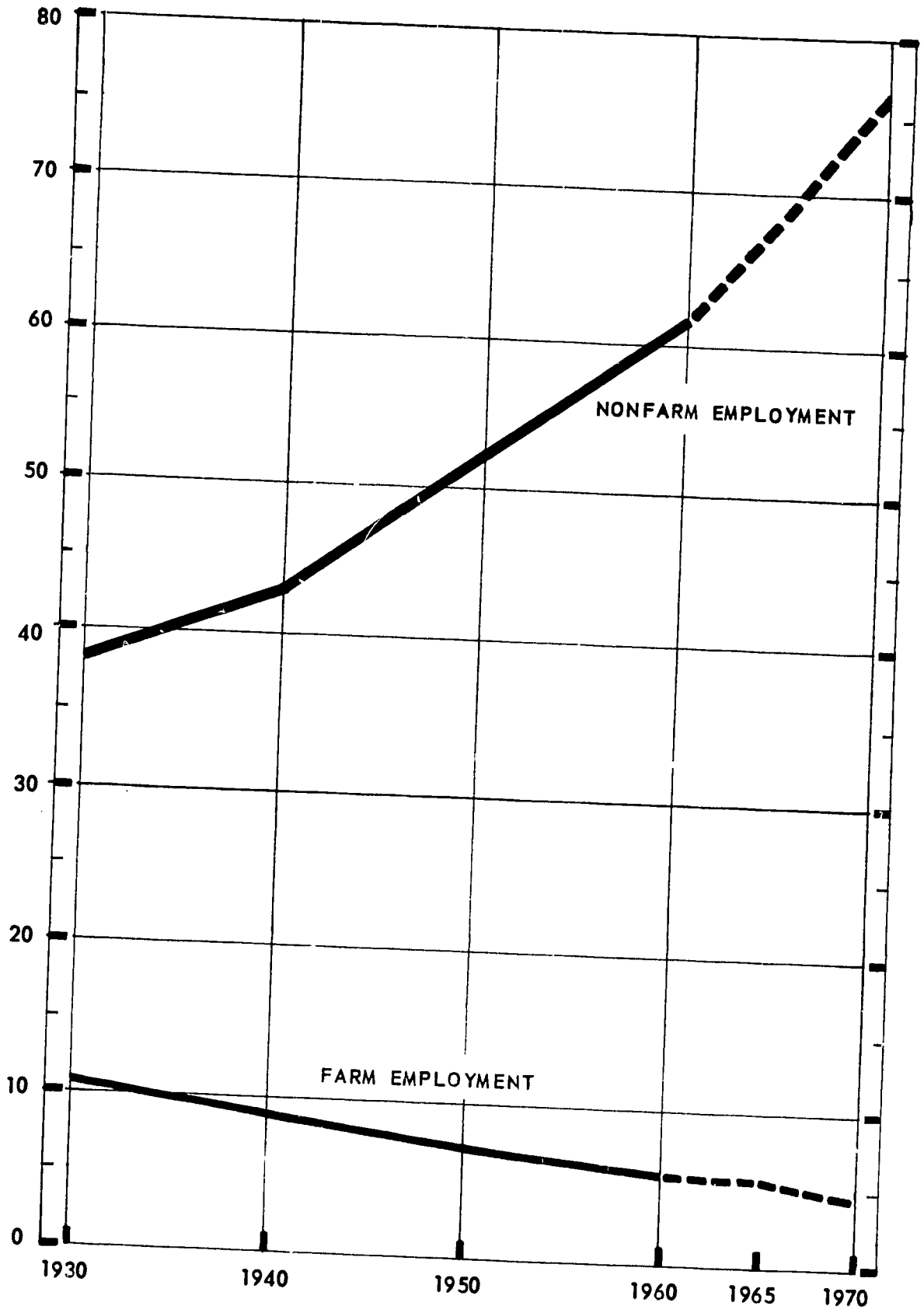
During the twenty years from 1930 to 1950 the population of the United States increased by just over 29 million — that is, by 23 per cent. Since 1950, the average annual increment, which was just under 1.5 million during the period 1930-50, has doubled to a rate of nearly 3.0 million a year. As a consequence, over 60 million people will be added to the population during the twenty years from 1950 to 1970 — twice as many as during the preceding twenty years. This represents an increase of 40 per cent in less time than it takes a child to go from birth to university graduation.

POPULATION GROWTH 1930-1970

YEAR	POPULATION (MILLIONS)	INCREASE DURING DECADE	
		(MILLIONS)	(PERCENTAGE)
1930	123.2	—	—
1940	132.6	9.4	7.6 %
1950	152.3	19.7	14.9
1960	180.7	28.4	18.6
1965	196.2	—	—
1970	214.2	33.5	18.5

The net increase of 33.5 million between 1960 and 1970, which takes account of deaths as well as births, does not reflect the full impact of population growth on the educational system. If, as expected, the high post-war birth rate (about 24 per 1,000 population) continues, more than 40 million babies will be born in the United States during the 1960's (some estimates go as high as 47 million). However, the educational problem of the next decade is not a function of this expected influx of babies. The number of students at all levels who must be accommodated by 1970 does not depend on the actual presence of the 214 million people estimated for that year. The school population for 1970 is already here.

Chart 1. TREND IN FARM AND NONFARM EMPLOYMENT 1930-1970



In passing, it might be noted that the decline in the death rate and the lengthening of the span of productive years — which is being brought about by the greatly expanded medical research programme in the United States — is also an important economic and social factor. It is predicted that between 1960 and 1970 the life expectancy for men will be lengthened by three years (to 69 years) and that the population over 65 years of age will increase by 25 per cent (to 20 million). On the other hand, immigration, while not negligible, is not now a major factor in population growth. During the 1950's it averaged only 250,000 a year which represents an annual population increment of less than one-sixth of one per cent.

A second powerful force affecting higher education in the United States is the speed and manner in which the economy is changing. This change has many aspects but one of the most fundamental is the transformation of the United States from a predominantly agricultural to a highly industrial nation and the consequent movement of people from the farms to the cities.

In spite of the enormous population growth there has been a steady and quite rapid decline in rural population and farm employment with, of course, a corresponding rise in city population and industrial employment. The 1960 census showed that the rural population was nearly half-a-million less than it had been in 1950, while the urban population had increased 29 per cent during the ten years. This phenomenon is evident throughout the country — between 1950 and 1960 the urban population increased in each of the fifty states and now exceeds the rural population in 39 of them. Nationally, the proportion of the population classified as living in urban communities grew from 56 per cent in 1930 to 64 per cent in 1950 and to 70 per cent in 1960. This trend is still continuing.

Moreover the majority of workers who live in what the census-takers define as rural areas do not in fact work on farms. In 1930, more than one-fifth of the labour force was engaged in farming ; now the proportion is less than one in ten. What is even more significant is that the actual number engaged in farming (a little over six million) is less than 60 per cent of the number so engaged in 1930. This shift reflects profound economic and social changes which exert major pressures in the educational system.

	EMPLOYED CIVILIAN LABOUR FORCE	EMPLOYED FARM WORKERS	
	(MILLIONS)	(MILLIONS)	(PERCENTAGE)
1930	45.5	10.3	22.6 %
1940	47.5	9.5	20.0
1950	59.7	7.5	12.6
1960	66.7	5.7	8.6

One of the most important of these changes is in the kinds of jobs in which people are employed. Since 1955, the number of people engaged in professional, office and sales occupations in the U.S. has for the first time exceeded that in manual occupations. Similarly, the service occupations now exceed farming in their demand on the labour market. The proportion

Chart 2. EMPLOYMENT BY OCCUPATION 1950-1970

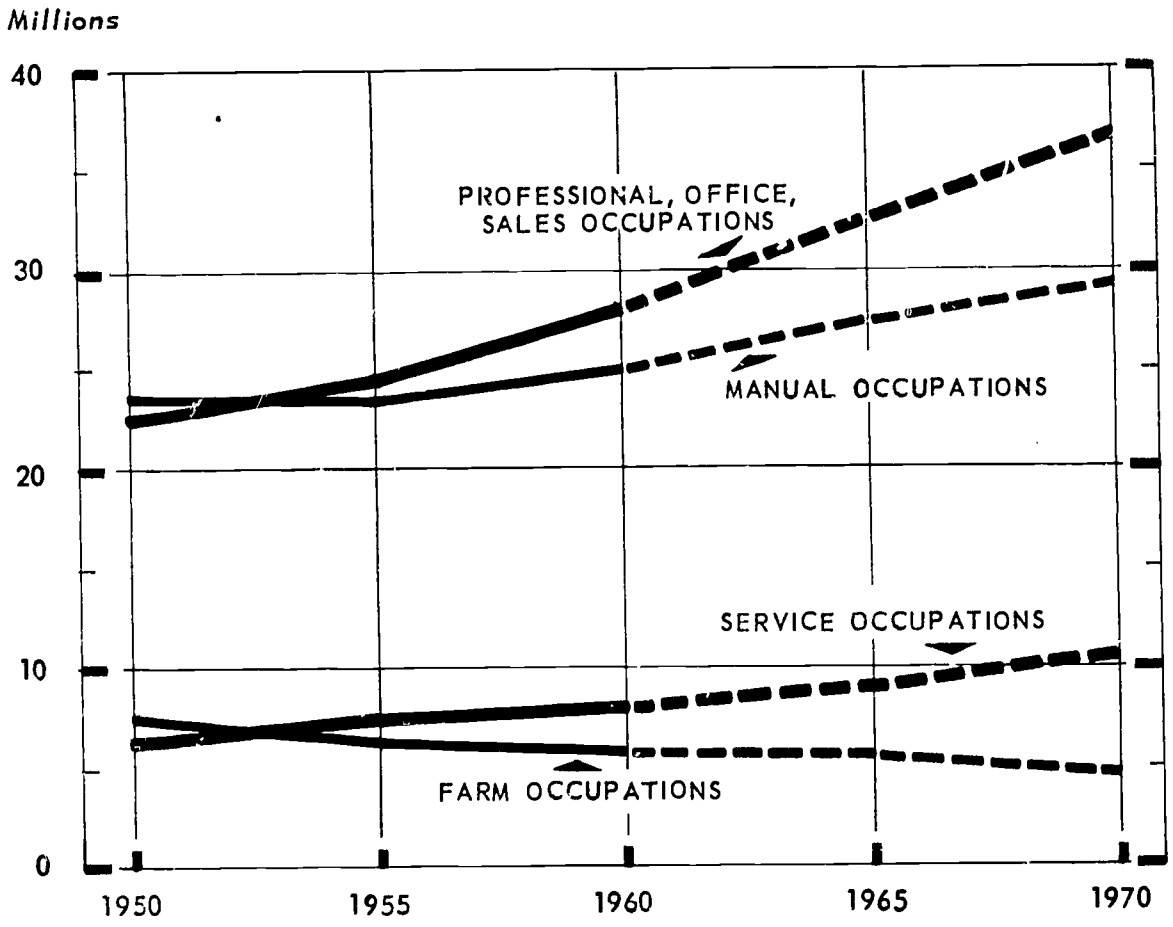
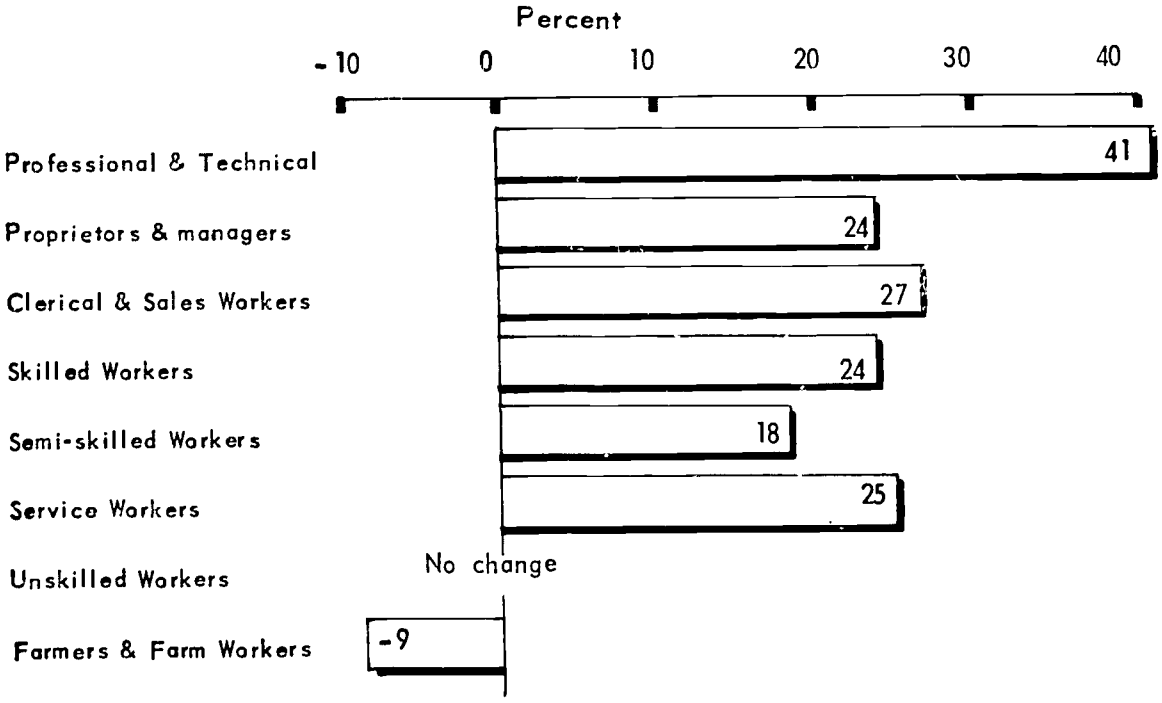


Chart 3. PERCENTAGE CHANGE IN EMPLOYMENT 1960-1970



of those in professional and related highly skilled occupations is growing rapidly and there is every indication that this trend will continue not only throughout the 1960's but almost certainly into the more distant future.

Estimates of the probable changes in employment between 1960 and 1970 show that the fastest growth in demand for manpower will be in the professional and technical occupations, especially for scientists, engineers and technicians. This category of employment is expected to grow almost twice as fast as any other, increasing by more than 40 per cent during the ten years. Among the manual occupations, the need for skilled craftsmen will increase while the number of unskilled jobs will remain fairly constant and will thus absorb a progressively smaller proportion of the labour force. It should be noted that the number of people engaged in farming is expected to decline still further.

The educational implications of these projections are obvious since they clearly show that the job opportunities which, in future, will exist in greatest numbers are those requiring the most education. The economic and social changes now taking place in the United States are placing an increasingly high premium on higher education. As of 1960, professional and related technical occupations accounted for nearly 7.5 million people.

PROFESSIONAL EMPLOYMENT IN 1960

Scientific & Technical Professions		1,860,000
Scientists	335,000	
Engineers	850,000	
Technicians	675,000	
Teachers		1,830,000
Higher Education	280,000	
Secondary Schools	580,000	
Elementary Schools	970,000	
Health Professions		1,629,000
All other Professions		2,160,000
Total		7,479,000

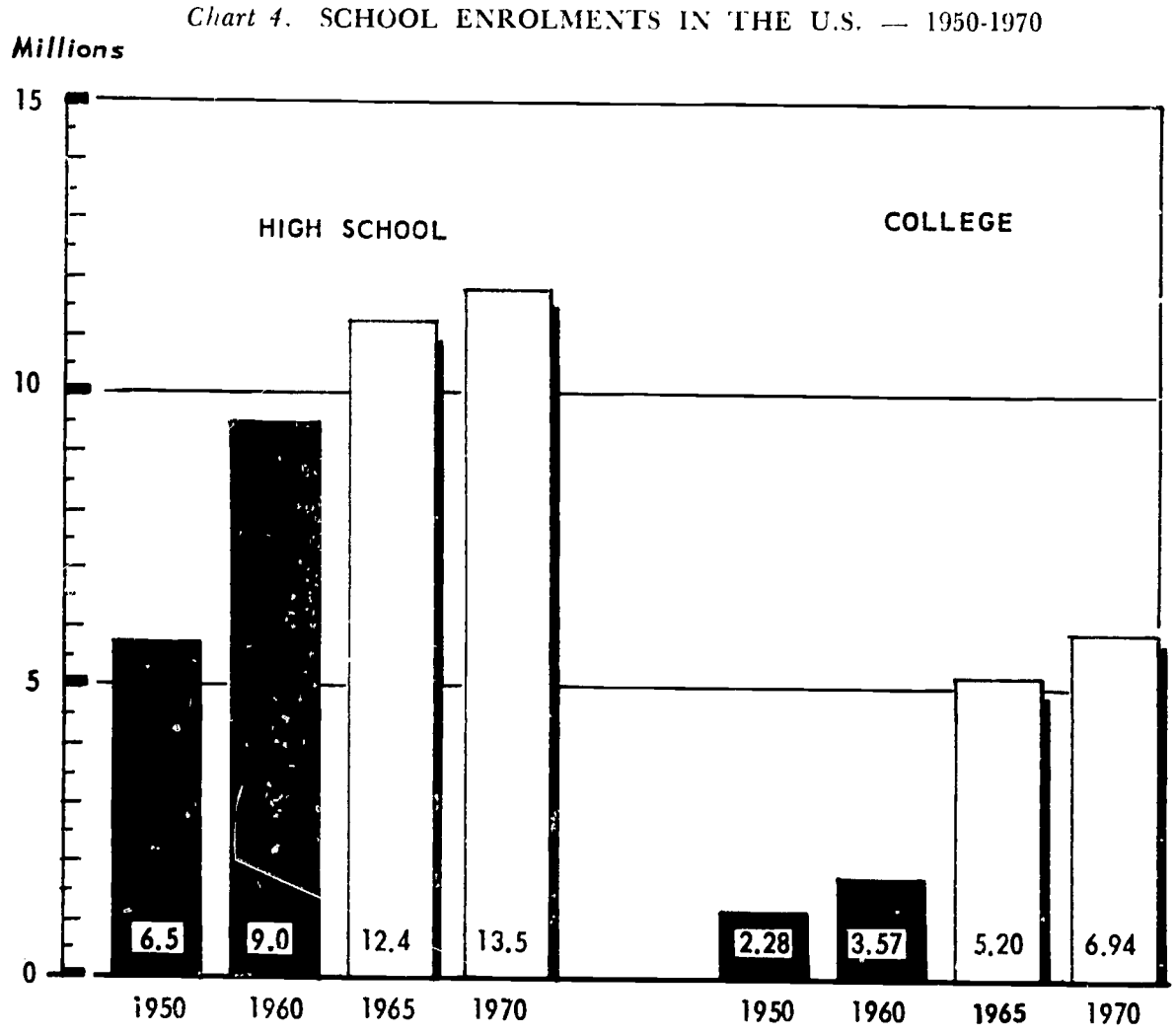
The projected increase means that by 1970 this total will have to grow to nearly 10.7 million. Most of this increase will have to be found in the scientific, technical, teaching and the science-based health professions which are already by far the largest professional groups and which are also growing at the most rapid rate.

There is virtually no entry into any of these groups except by the avenue not only of higher education but of *complete* higher education which, for many fields, includes a number of years of post-graduate professional education.

The growth of population and the concurrent rapid economic and social changes have created many pressing educational problems. First of all, there has been a tremendous increase in school enrolment at all levels and the prospect immediately ahead is for an even more formidable increase.

Secondary-school (high-school) enrolment, which increased by 40 per cent during the 1950's, will increase another 50 per cent during the 1960's. It is expected that in 1970, 92 per cent of the 6 to 18 age group (the usual span of elementary and secondary school) will be in full-time school attend-

Chart 4. SCHOOL ENROLMENTS IN THE U.S. — 1950-1970



ance. This is probably as near to universal education for that age group as it is possible to get.

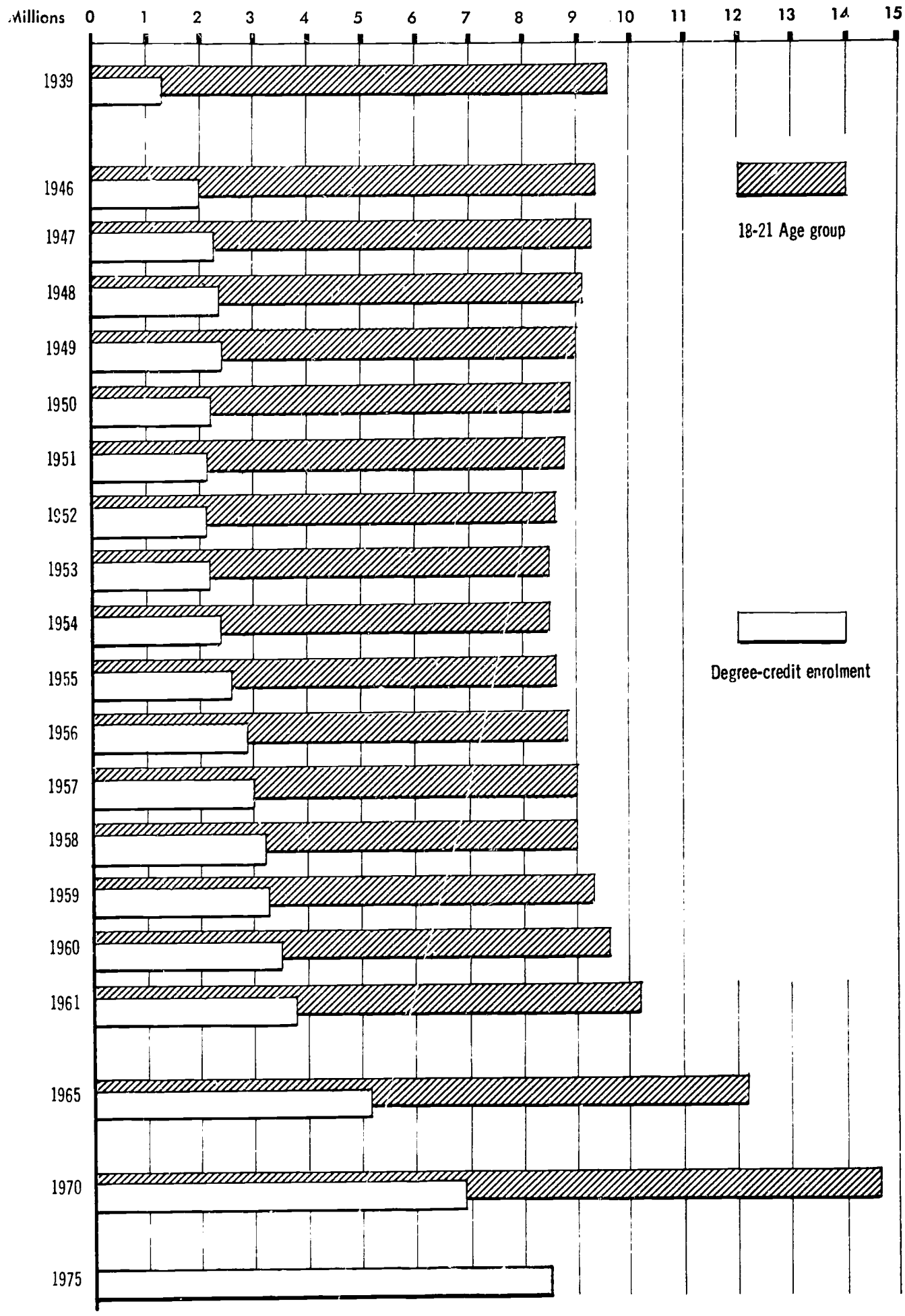
As a constantly growing proportion of high school graduates is seeking a college-university education, the increase in high-school enrolment will be even more sharply reflected in future college enrolment figures. The total number of students attending college, which also rose by 40 per cent during the 1950's, is expected to rise by a further 70 per cent during the 1960's.

In terms of college enrolment, counting only those students intending to take a degree, this means that the number of students, which rose steadily from 2,100,000 in 1951 to 3,850,000 in 1961, will grow to 6,936,000 by 1970. Nor is this the end of the expected college expansion ; current estimates envisage another 24 per cent increase during the period 1970-75 for a total degree-credit enrolment of 8,600,000 in 1975.

The ratio of degree students to the 18-21 age-group has already risen from the pre-war figure of 14 per 100 to over 37 per 100 and is expected to reach 47 per 100 by 1970. There is little room for doubting the broad validity of this projection. The students who will make up the nearly 7 million enrolment of the colleges in 1970 are already in school and some of them are already in the high schools.

The spectacular rise in the proportion of high school students going on to college is a highly significant feature of the educational evolution in

Chart 5. TOTAL DEGREE-CREDIT ENROLMENT IN RELATION TO POPULATION AGED 18-21 FALL 1939, FALL 1946, THROUGH FALL 1961, AND PROJECTED TO 1975



	ESTIMATED POPULATION[1] AGED 18-21 (IN THOUSANDS)	TOTAL DEGREE-CREDIT ENROLMENT[1]	No. OF STUDENTS PER 100 POPULATION[2] AGED 18-21
1939	9,582	1,364,815	14.2
1949	8,990	2,444,900	27.2
1950	8,948	2,281,298	25.5
1951	8,763	2,101,962	24.0
1953	8,487	2,251,054	26.3
1955	8,577	2,653,034	30.9
1957	8,935	3,036,938	34.0
1959	9,293	3,364,861	36.2
1961	10,231	3,845,956	37.6
Projections :			
1965	12,153	5,203,000	42.8
1970	14,573	6,936,000	47.6

1. Figures do not include Hawaii and Alaska.
2. The ratio of students per 100 in the 18-21 age-group must not be interpreted as a percentage of the age-group because the student figure includes a substantial proportion who fall outside the age-group. Thus in 1960, when the ratio stood at 37.2, it was estimated that between 20 per cent and 25 per cent of those actually in the 18-21 age-group were degree students. The projected ratio of 47.6 for 1970 can probably be assumed to include about one-third of the 18-21 age-group.

the United States. The problems presented by this phenomenon are complex and pressing. Among the questions which need urgent answers — because time is short — are : How can the educational facilities of the country be expanded to meet the demand ? ; How can the teachers be found ? ; How will the bill be paid and by whom ?

Public discussion of these questions, to which no satisfactory and generally acceptable answers have yet been found, is serving to create in the United States a climate of opinion in which education has almost become a national obsession.

Both parents and children are becoming more and more convinced that occupational opportunities and the prospect of economic and social success are virtually determined by the level and kind of educational attainment a youngster can achieve. Although the value of education has long been generally recognised, the growing prevalence of the view that a college education is almost the only road to success is a new and somewhat unexpected development in a country where the self-made man has been so much respected and admired. Americans believe that their standard of living can be maintained and continue to rise only if more people receive more education — that the kind of society which is being created in the United States cannot be operated and developed by a population only a small part of which is highly educated.

Whatever their views about the national need for education, most people also have selfish raisons for wanting the best possible education for themselves or their children. There is a general awareness not only that a person with only a secondary school education is at a disadvantage in the employment market but that total lifetime earnings can in some measure be directly related to the level of education reached.

The statistical evidence for this relationship should not be pressed too far — perhaps it shows only that competent people earn more money

Chart 6. LIFETIME EARNINGS BY YEARS OF EDUCATION

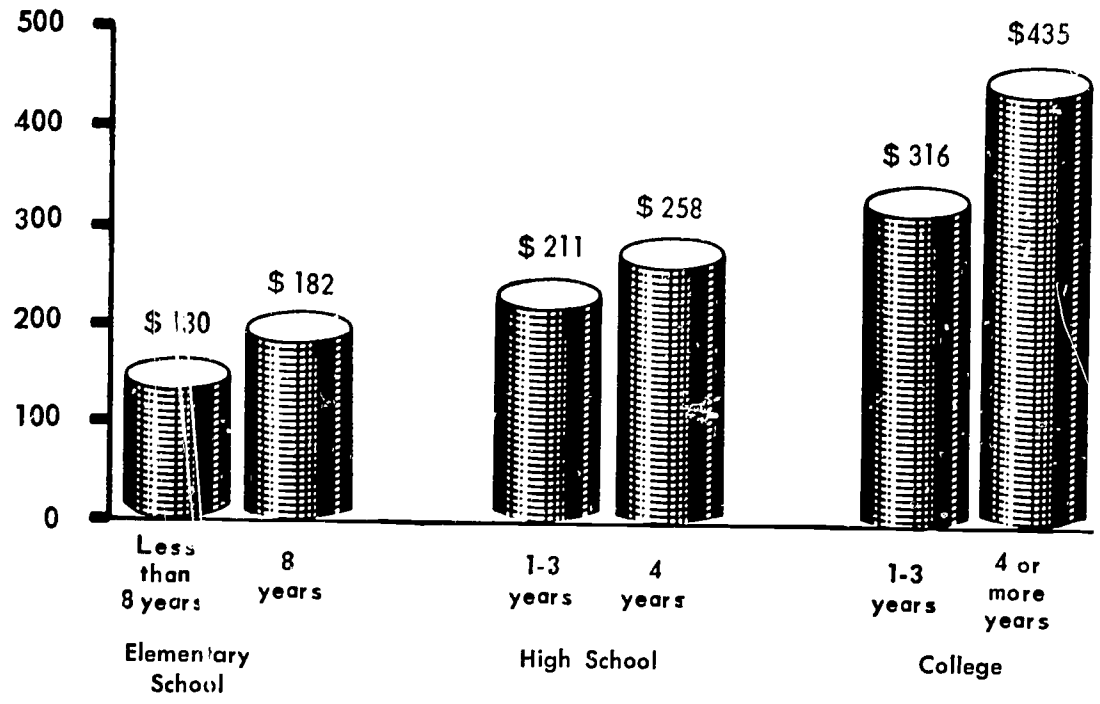


Chart 7. PERCENT UNEMPLOYED BY OCCUPATIONAL GROUP 1960

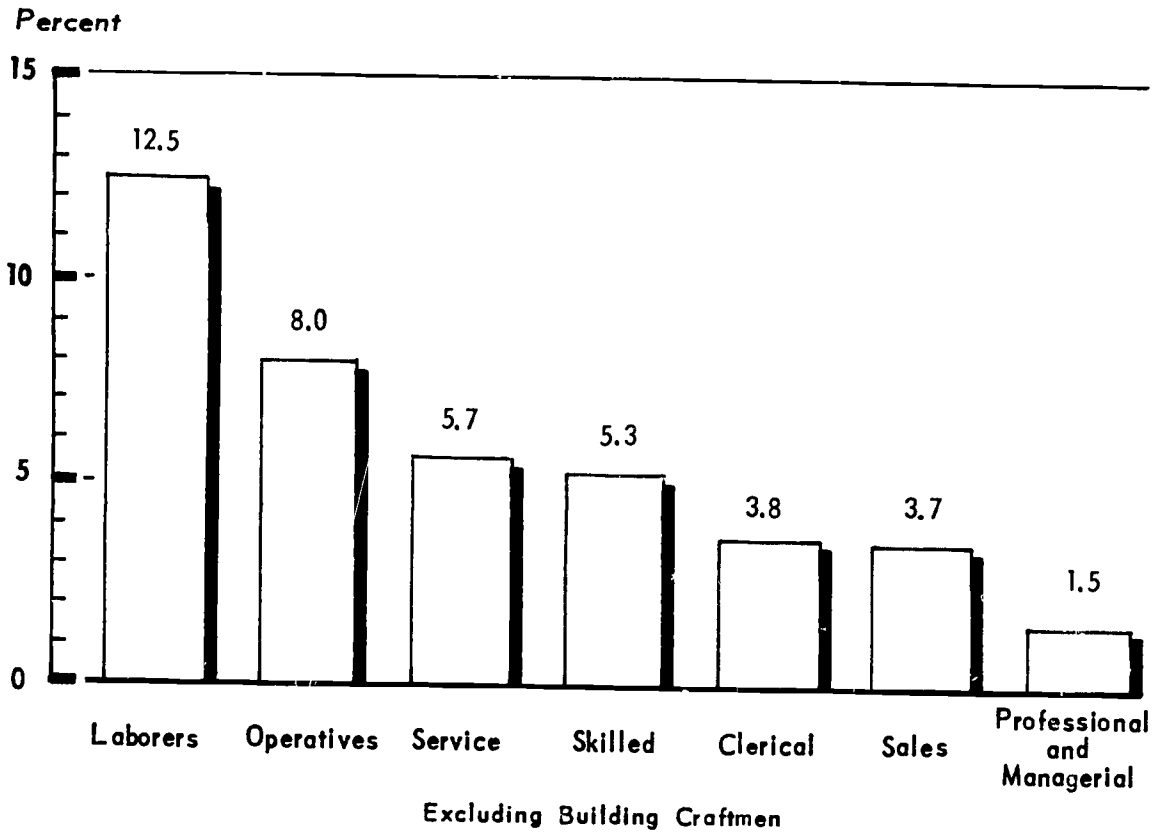
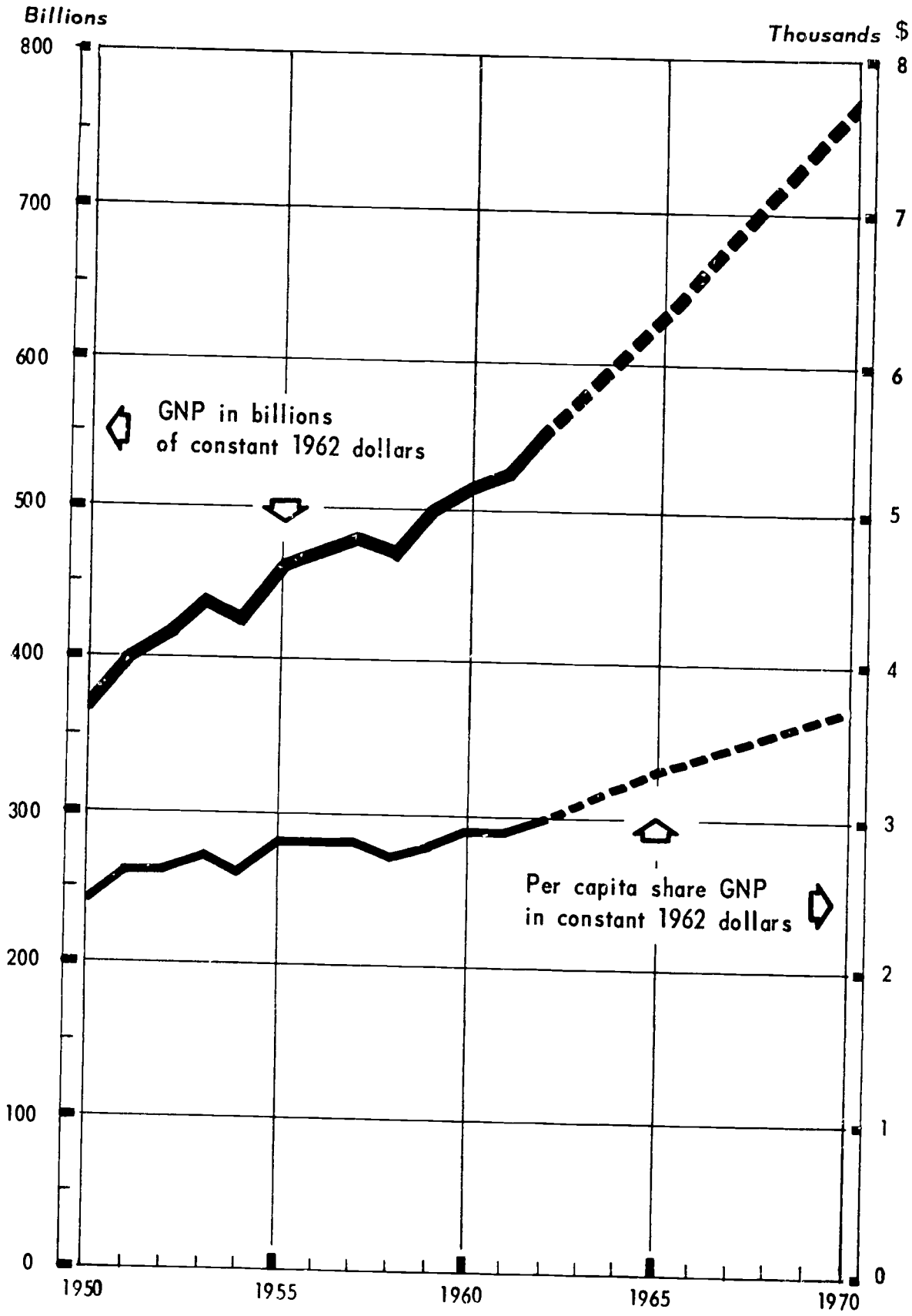


Chart 8. GROSS NATIONAL PRODUCT 1950-1970
IN 1962 PRICES



and also tend to go to college. But broadly speaking there are good grounds for such slogans as "the more you learn, the more you earn", and there is ample evidence to support the prevailing belief that, quite apart from its cultural and social advantages, an investment in education is likely to yield high economic dividends.

It was Oliver Goldsmith, the 18th century poet, who wrote :

"For just experience tells, in every soil,
That those who think must govern those that toil."[1]

In the complex economic society of the latter half of the 20th century this relationship is even more inescapable. Not only does education pave the way to more responsible jobs and better pay but, the statisticians say, it also provides an effective form of job insurance. For example, a survey in March 1959 showed that, at a time when 7.0 per cent of the workers with only an elementary school education were unemployed, the unemployment rate among those who had finished high school was 4.8 per cent and among those who had done some post-graduate work it was only 0.7 per cent. A later survey (in 1960) by occupation similarly showed that there is an inverse relationship between the rate of unemployment and the level of education usually required for admission to the occupational group.

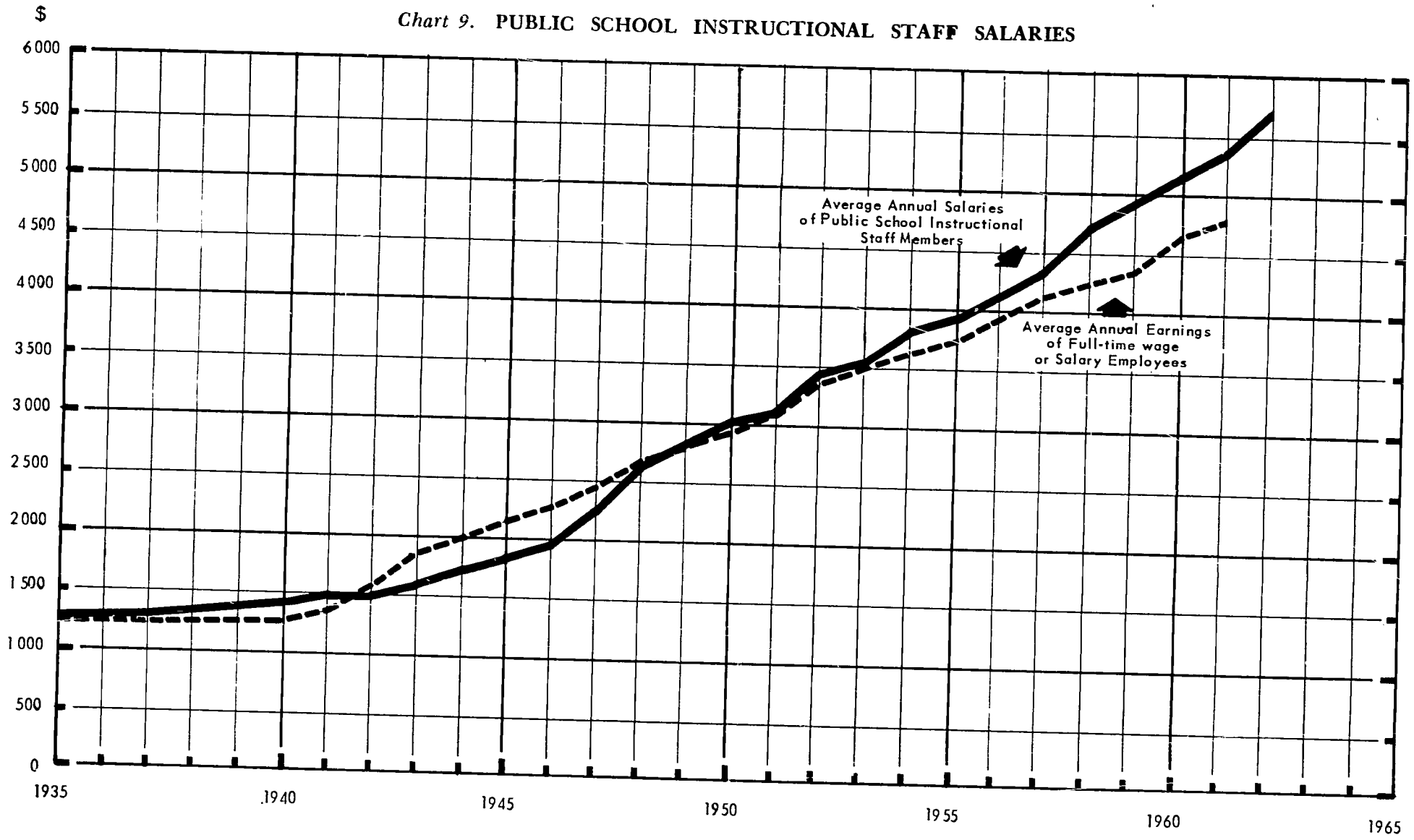
These statistics can, of course, be equally well taken to illustrate that there is a relatively greater demand for people with professional and managerial skills. This is not the place to enter into a more sophisticated discussion of the many conditions affecting wage and employment rates. Suffice it to say that an awareness of a relationship between education and such factors as earning capacity and job security is stimulating an enormous demand for higher education in the United States. Meeting this demand will require the marshalling of the resources and the co-operation of students and parents who pay the tuition fees, the business community which is dependent on an adequate supply of highly trained people, and all three levels of governments — local, state and federal — which have been delegated the joint task of meeting national needs and satisfying popular aspirations.

It is hoped that the growth of national income, a continued rise in the level of productivity and an increase in the amount of average family income will go a long way toward solving the financial problems posed by the desired expansion of educational facilities and opportunities. If the projections for the Gross National Product — and for personal income — are realised, there should be a sound economic base for meeting the cost, though there will still be awkward questions and sharp disagreements about the way in which the financing should be handled.

Although financing and facilities can be fairly quickly provided, once a course of action has been agreed, the availability of suitable faculty presents a problem less amenable to rapid solution. Competent teachers cannot be created in a few months. In a free society the right people in the right numbers cannot be driven but must be attracted into teaching. The prime attraction, of course, is remuneration. For a number of years the relatively low level of teachers' salaries in many areas has been a major impediment to overcoming the shortage of qualified teachers, especially in the elementary and secondary schools. Fortunately, the picture is chang-

1. *The Traveller* (1764)

Chart 9. **PUBLIC SCHOOL INSTRUCTIONAL STAFF SALARIES**



ing. Up to about 1950, average salaries of public-school teachers lagged behind industrial salaries and wages and, consequently, many teachers, especially in the sciences, went over to industry. Since 1950 — and especially since 1957 — teachers' salaries have been rising at a rapid rate. Although there are still areas in which teachers are badly underpaid, their average salaries are now higher than the general average for industrial employees though — with some exceptions — they usually do not yet compare favourably with professional salaries.

In the five years since 1957, the average salary of secondary school classroom teachers has risen by 27 per cent to $5,775 and that of elementary school classroom teachers by 33 per cent to $5,340.

AVERAGE ANNUAL SALARIES

	SECONDARY SCHOOL TEACHERS	ELEMENTARY SCHOOL TEACHERS	INDUSTRIAL WAGE & SALARY EMPLOYEES
1951	3,375	2,765	3,120
1957	4,560	4,025	4,121
1961	5,543	5,075	4,781
1962 (est.)	5,775	5,340	n.a.

The change in the attitude of state legislatures, school boards and taxpayers to teachers' salaries is only one facet of the awakening national concern with the tremendous task of equipping the educational system — from kindergarten through the university-graduate school — to cope with the tasks that the rapid growth in population and the spreading desire for more education is forcing upon it. Public debate of the issues involved is widespread and, unfortunately, sometimes acrimonious. There are serious political and, indeed, constitutional issues which must be resolved before some of the financial and operational problems can be tackled. Ultimately it is the ordinary citizen — the voter and taxpayer — who must choose the course and foot the bill. Efforts to inform and stimulate him are not lacking. An interesting example of such an effort is the campaign conducted by the Advertising Council, a non-profit public service organisation set up and financed by the advertising industry, to encourage both private gifts to colleges and family saving to enable the children to have a college education. This campaign has included large roadside advertisements, one-minute films shown between changes in television programmes and extensive advertising in popular national magazines for which the space, had it been purchased, would have cost over $225 million. The tenor of the message conveyed is illustrated by one of the slogans used : "When your son is ready for college, will the college be ready for him?". The effect of this campaign on bequests to colleges and on family budgeting is difficult to assess but its psychological effect is clearly to spread and reinforce the notion that a college education is part of every American child's birthright.

The interest of business in the support of education is both altruistic and practical. Prominent industrial firms have for many years made substantial contributions to building, research and scholarship funds. In recent years the economic importance of education has, however, become

a conscious factor in business thinking. One New York newspaper, which is not normally accused of holding liberal views, put the matter bluntly when the New York State Legislature was in the midst of debating an important school aid bill. Its succinct editorial said simply: "Of course we are in favour of state aid to local schools. Damn it, we can't sell papers to people who can't read!"

3. THE SCIENTIFIC AND TECHNICAL MANPOWER SHORTAGE

Before discussing the nature and extent of the probable shortage of scientists and engineers in the United States and what steps will be taken to meet the expected need, Prof. Svennilson asked what degree of reliability can be attributed to existing forecasts of supply and demand.

Basic statistics, he observed, are of a very high standard in the United States, and forecasts based on them are skilfully elaborated. Nevertheless, the factors that must be taken into account in making forecasts involve great uncertainties and these uncertainties inevitably increase the further one attempts to look ahead. Forecasts of the shortage of engineers, for example, are based on the expected growth of the various sectors of the economy, on assumed changes in the ratio of technically trained people to total employment in these sectors, on the probable ratio of engineers to technicians, and, as regards the supply side, on projections of the increase in college and university enrolment, on assumptions about the proportion of those students who will embark on engineering courses and on estimates of the number who will actually complete their studies and enter the engineering profession. Each of these steps involves uncertainties which cumulatively result in a very large margin of error. It is possible, therefore, that the expected annual shortfall of 14,000 engineering graduates in the United States[1] during the 1960's (resulting from an output of 58,000 against a need for 72,000) lies within the margin of uncertainty. This raises the question whether it is worthwhile to make this kind of forecast or to draw very far-reaching conclusions from it.

Such estimates, Prof. Svennilson suggested, should be regarded as expressions of policy rather than as predictions of future supply-demand positions. Perhaps all that can reasonably be done is to estimate the total number of students who will be enrolled in institutions of higher education and then to establish targets for the various branches of learning — science, engineering, medicine, the humanities and so on. Such a distribution pattern would be less a statement of need than an expression of policy — a policy not only for education but for the development of society as a whole. In this approach demand is not regarded as being independent of supply (resulting in equations with two independent variables yielding shortages or surpluses) but as a function of supply. Policy is therefore focused on the supply side recognising that the growth of the economy and the direction in which society will develop are very much determined by the relative availability of people with various kinds of education. The problem then is to discover what can be done to induce students to enter the various fields in roughly the desired proportions.

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1. cf. Examiners' Report, para. 12.

This view, according to the American delegates, is widely shared in the United States. Demand, in general, is not regarded as a free-moving, self-determining factor but as dependent on the supply. The principle that demand will, in the long run, create a matching supply is balanced by the observable fact that, in a relatively free economy and an enterprising social climate, the existence of an unabsorbed supply will often stimulate entrepreneurs to think of uses to which it might profitably be put. (Dr. Tyler cited as an example the development in the San Francisco area of an extensive electronics industry resulting from the existence of a supply of people well-trained in electronics at Stanford University.) Statistical estimates and analyses of future supply-demand relationships should thus be read as predictions of the ability of the economy to absorb possible increases in the supply rather than as prescriptions for the provision of specific numbers of engineers and other professional personnel to meet spontaneous needs at some future point in time.

In any case, the major emphasis in American planning for the future is on quality rather than quantity. There is less concern that the number of trained people may fall short of the jobs that must be filled than that their level of competence may fall short of the work that must be done. Experience has shown, especially during the war, that American manpower is very flexible — that people can, and do, move fairly readily from one field of endeavour to another. It can therefore be assumed that most of the scientific and engineering jobs that will exist in, say, 1970 will be filled by *someone*. It is doubtful, however, if national needs can be adequately met during the next decade unless such jobs are filled by people trained to the highest levels of competence in institutions that are themselves centres of excellence.

The President's Science Advisory Committee recently examined the problem of quality and concluded, without attempting to quantity future needs, that it would clearly be in the national interest to have as large a supply of high-level personnel (i.e. with Ph.D. degrees) as possible in the physical sciences, mathematics and engineering. The recommendation of the P.S.A.C. was that the annual output of Ph.D.'s in these fields should rise from 2,900 in 1960 to 7,500 in 1970. This target figure was not based on an uncertain analysis of potential demand in 1970 but on the conviction that the highest development of individual skill is a country's most valuable resource, and on educational output statistics which showed that the proportion of those with first-degrees (baccalaureates) going in to doctorate degrees is now far below the optimum. For example, less than 4 per cent of the engineering graduates in the United States now go on to take a Ph.D. degree — it is hoped that this proportion can be doubled by 1970. Similarly, it is hoped that the number of doctorates in mathematics can be increased from 8 per cent to 16 per cent of those who did their undergraduate work in mathematics.

The P.S.A.C. report illustrates a marked difference, as M. Poignant (France) pointed out, between the American attitude towards education at the advanced level and that of many European countries which, he said, "are not unanimously in favour of developing post-graduate education". He described the report as "a well-thought-out, systematic policy for developing science education at the highest level" and added, "I believe all European countries must recognise this and take it as an example."

Although American plans are primarily designed to serve broad, long-term national interests rather than to meet specific shortages, there are a number of large-scale activities, for which fairly accurate estimates of future demand for scientists and engineers can be made, that must be taken into account. The requirements of the defence establishment, assuming that there is no dramatic change in the international situation, can be projected with some degree of accuracy. So also can the needs of the space programme which, on the basis of existing plans, will employ a considerable proportion of the number of additional scientists and engineers included in the demand predicted for 1970.

A special and quite serious problem is the impending — and predictable — shortage of engineers that will result from the decreasing enrolment in undergraduate engineer courses during the past five years. Although college attendance has risen rapidly during this period, the number of engineering students has steadily declined. This decline has now begun to be reflected in a reduction in the number of engineering degrees awarded.

The problem is complicated by the fact that, in addition to the decline in initial enrolment, there is a very high drop-out rate among engineering students — about 65 per cent in the State universities and about 45 per cent in the private universities, even though the latter are more selective and may be presumed to admit only those students who are intellectually capable of and adequately prepared for university work in engineering.[1]

While enrolment in graduate courses in engineering — contrary to the trend in undergraduate enrolment — has been increasing, there is, as Dr. Beadle pointed out, also a tendency for more and more advanced-level students at institutions long noted for the excellence of their engineering courses (such as the Massachusetts Institute of Technology and the California Institute of Technology) to choose science and mathematics instead of engineering. However, the gap between science and engineering courses at these institutions has become narrower and narrower, and Dr. Beadle was convinced that many of these science students would go into industry as applied scientists to do the type of work formerly done by engineers. Indeed, he expressed the view that, as industry becomes more sophisticated, engineers are being replaced by mathematicians, physicists, chemists and others who by their formal training would be classified as scientists. Dr. Hill noted that it is now, in fact, usual for the first two years of the engineering curriculum to be devoted to basic science courses but he added that there is a growing body of opinion in industry that this is not all to the good. The engineer's function is essentially different from that of the scientist. The scientist must do the basic work and create new knowledge on which development is based ; the engineer must take this knowledge and, by introducing economic and social considerations, adapt it to the useful service of society. Engineering is thus partly a matter of attitude and, unless this is instilled fairly early in the engineering curriculum, there is a risk that the student will not acquire the engineering viewpoint. Industry needs men with a flair for problem-solving under the realistic pressure of limited time and money.

1. For further discussion of the drop-out problem see p. 93.

The general question of the utilization of engineers and other professional personnel was raised by Sir Willis Jackson (United Kingdom) who pointed out that apparent shortages at the professional level are often due to the even greater shortage of well-educated and well-trained technicians. Quite a lot of the work now done by professional people could, with a little replanning, equally well be done by people with lower qualifications. He suggested that a serious effort to quantify the supply and demand estimates for the various sub-professional levels might well affect American estimates of need at the professional level.

Dr. Dees acknowledged that the United States has been rather slow to recognize the need for more technicians partly because this need has been obscured by the fact that, in far too many cases, professional people are being used, as Sir Willis said, in what should have been technicians' jobs. Though little has yet been done to quantify it, the technician problem is of growing concern and is beginning to receive serious attention because it is realized that the U.S. can no longer afford to use fully trained engineers, for example, as draughtsmen or surveyors or in other sub-professional capacities. The President's Science Advisory Committee has, in fact, asked one of its special panels to study the problem. Meanwhile, legislative notion is also being sought. One of the provisions of the administration's education bill[1], introduced in Congress on January 29, 1963, would create a substantial Federal grant programme to assist in establishing or expanding college-level technical education in order to increase the supply of engineering and other semi-professional technicians.

Another drain on professional manpower (also mentioned by Sir Willis Jackson) is that a substantial proportion of those who receive professional degrees do not go into the technical field for which they have qualified. This is especially true among engineers many of whom go into the selling of technical equipment or services or enter management. Dr. Dees emphasized, however, that this diversion into more general activities is by no means a net loss and cannot properly be described as social wastage. Professor Elvin (United Kingdom) pointed out that there is also a flow in the opposite direction : people with arts degrees go into managerial jobs in technological firms, thus, in effect, releasing engineers for the practice of their profession. Nearly every estimate of a shortage in a given profession, he said, makes the doubtful assumption that people do only the work for which they are trained when, in fact, a great number of people do jobs in middle age for which they were never trained at all. Dr. Tyler commented that this is one of the arguments for raising the general educational level of the population. A recent study in the United States has shown that the more education people have had the more likely they are to make the effort to get whatever special training they may later find useful. The higher the level of education initially provided, the easier it will be, therefore, to meet urgent special needs simply by providing the necessary supplementary educational opportunities.

A more serious diversion than the use of engineers for sub-professional work, in the view of the American delegation, is the fact that so many of those who are trained to become teachers, especially secondary school teachers, do not do so. A substantial portion of these teachers are women

1. H. R. 3000 ; Title II, Part C.

who marry shortly after graduation. This, of course, is not an undesirable social phenomenon but it is, nevertheless an immediate loss of trained personnel that the country can ill-afford. There is much concern on this score, and a concerted effort is being made to find ways of bringing suitably educated women back to teaching when their children are old enough to make it feasible. As many of those women will have been away from professional work for more than a decade, special retraining programmes will have to be developed.

M. Poignant drew attention to the fact that the shortage of qualified science teachers in the high schools has been a major impediment to efforts to expand the output of scientific and technical personnel in which there has been only a relatively slight growth during the past seven or eight years. Whereas the greatest strength of the Soviet Union, in so far as scientific and technical personnel is concerned, is the very high level of the scientific and mathematics curricula in the secondary schools, this is the weak point in the American system. It is quite clear that the United States is well aware that a great effort is needed to change this situation. Nevertheless, the examiners' report[1] shows that the National Science Foundation's programme for retraining science teachers has touched only half the high-school science teachers in the United States ; the problem of improving quality remains. Its solution will, moreover, be made more difficult by the rapid expansion of institutions of higher education entailing a large number of additional teachers and competition with the secondary schools for graduates with suitable training in science. The problem of simultaneously staffing two expanding segments of the educational system — the same problem, M. Poignant said, also exists in France — could have been foreseen and a solution should have been sought out in advance. Although it is never too late to start, the time factor is inescapable and quick results can therefore not be expected.

The American delegates agreed that improving the quality and extent of science and mathematics teaching in the high schools is one of the most urgent and also one of the most difficult educational problems in the United States. Despite the steps that have already been taken, there is still a very long way to go before the problem will be solved. At the same time, it is encouraging that, as Dr. Beadle reported, many institutions of higher learning — especially the major institutes of technology — are now finding that entering students are generally better prepared and further advanced in mathematics than they were a few years ago.

An effective solution of the teacher problem, however, cannot be achieved for a number of years not only because it takes time to train teachers but because of the unavoidable effect of the abrupt post-war change in the birthrate. Dr. Tyler pointed out that during the 1930's and early 1940's births averaged about 2.5 million a year but since the war they have averaged about 5 million a year. This means that new teachers must be drawn from a population group that is only a little more than half the size of the population group they must teach. As a result, the proportion of young adults who should become teachers is almost double that required by a more static population. Not until 1969, when the first of the post-war babies will graduate from college, will the effect of this disparity begin to

1. Para. 122.

disappear and the potential teacher supply come once more into reasonable balance with the school-age population. The present gap is particularly unfortunate because it exists at a time when the proportion of youngsters completing high school and going on to college is rapidly increasing.

Improving the quality of science and mathematics teaching in the high schools and enriching the science and mathematics curricula are extremely important not only to provide adequate preparation for those who wish to become scientists and engineers but as the most effective way of inducing more students to elect a scientific career. In a free society, such as that of the United States, any increase in the number of entrants into a professional group must be the cumulative result of individual career decisions. Providing the necessary motivation for the student is therefore a prerequisite for the success of any national manpower plan. It is, of course, well-known that a highly competent and inspiring teacher, who can lead young people to discover the challenge and intellectual satisfaction of science and mathematics, is by far the most effective recruiter of aspiring scientists and engineers.

The second — and traditional — motive for selecting a particular career is that it offers jobs with attractive salaries to people with the necessary qualifications. There is no doubt that the enhanced economic and social status of scientists since the war has done much to attract young people to science careers. Recent increases in teachers' salaries are similarly beginning to have an effect.

But a third factor, which should not be overlooked, is public awareness of national needs. While Americans are unwilling, at least in peacetime, to accept direction over what they regard as their personal affairs, there is a general willingness to undertake tasks which seem important to the public interest. Young people are anxious to find a useful niche in society ; the knowledge that some particular activity is important to society has a strong appeal that is independent of, but strongly reinforces, the more self-centred motives of economic reward and personal interest. To some extent, therefore, public discussion of the national need for more scientists and engineers will also help to solve the problem.

Dr. Tyler rejected the suggestion that a natural limit to the proportion of people who are endowed with the capacity for higher education may be the limiting factor in determining educational goals. He conceded that perhaps five centuries hence the demands of higher education may outrun the intellectual capacity of the majority of adults but for the present the practical problem is not to overcome whatever biological limitation there may be but to motivate people to want to learn.

The feasibility of assessing the reserve stock of young people who can profit from higher education was raised by M. Poignant (France). In Europe the percentages of children completing secondary school and of these going on to higher education vary considerably among the different social-professional classes. The potentially available reserve is certainly very high in the classes where this percentage is now very low. Governments must decide to what extent and how rapidly this reserve should be tapped, how much this would cost and how many teachers and how much school construction is necessary to do so.

American experience could be a valuable guide in this connection. Equality of education is the philosophy on which the American school

system is built. Whatever its short-comings, whatever the relative weakness of its teaching as compared with European education, its democratic character has an immense merit. M. Poignant was therefore disappointed that the examiners' report contained no analysis of students in higher education according to the social-professional category of the families from which they are drawn. Such an analysis, he felt, might well throw light on the reserves of intellectual talent that are available in the less-favoured social classes.

Dr. Halsey commented that in the United States the traditional European relationship of economic privilege to educational opportunity is lost from view because it is submerged by the expansion of secondary education to include virtually all children irrespective of family background. As a result, higher education rests on a fairly level base and social origin is far less closely related than in Europe to the attainment of a baccaulaureate or higher degree.

In the case of Ph. D. degrees, Dr. Stoke observed, there is almost an inverse relationship. An analysis of the colleges at which Ph. D. holders did their undergraduate work shows that very few of the graduates of the so-called 'class' colleges — those frequented by the sons of the economic and social elite — go on to take a Ph. D. degree. These graduates may enter law school or go to Wall Street — they succeed to important positions in business, industry and government but they do not follow academic careers and almost none of then become scientists.

In the United States, the Ph. D.'s come from among the graduates of the wide range of democratic colleges that draw their students from every social class and economic group. These colleges pride themselves on the proportion of their graduates who go on to become Ph. D.'s and they willingly accept a bright youngster without regard to the position of his father.

While the relationship in the United States between educational achievement and social origins is extremely tenuous, there is in some instances, as Dr. Tyler pointed out, a relationship between family background and choice of field. Engineering, for example, is more likely to be chosen by young people whose parents did not go to college than by young people both of whose parents have had a higher education. The latter are more likely to go into science or medicine or law. Family background is more likely to affect intellectual self-confidence than intellectual ability. It was found, for instance, that the sons of uneducated immigrants could be more readily attracted to higher education by a curriculum which combined working experience with classroom studies. An early opportunity to apply what was being learned not only served to convince these boys that further education was worthwhile but gave them confidence in their ability to think in more abstract terms about engineering problems.

M. Poignant drew attention to the difference in the socio-economic roles played by education in the United States and in Europe. In Europe, the average rate for completion of secondary school is about 10 per cent of the relevant age-group instead of 65 per cent as in the United States, and university degrees are earned by 3 or 4 per cent instead of 18 per cent. The standards reached are not exactly comparable but even so the difference is dramatic. The further prediction that the American figures will rise by 1970 to 80 per cent for high school diplomas and 25 per cent for bachelor's degrees shows how effectively the United States is moving in the direction of secondary schooling for everybody and higher education for the maximum

possible. It is obviously doubtful whether such an enormous increase in degree-holders is necessary to meet the needs of the economy but the United States believes — and is acting on the belief — that demand is a function of supply and that there is a self-adjusting relationship between the production of graduates and their effective employment. The United States, more than any other country, has accepted the principle that the educational system has a right to its own rate of development and that the economy must manage, by a process of constant adaptation, to absorb the increasing number of graduates. Such adaptation is possible because a rise in the level of education stimulates the economy and accelerates economic development thus making it possible to sustain a high proportion of graduates among the active population. The American philosophy of growth, in M. Poignant's view, sets an example for the development of European school systems.

4. THE ROLE OF THE FEDERAL GOVERNMENT IN FINANCING EDUCATION

The steps that will have to be taken in the United States to accommodate the rapidly rising enrolment at all levels of education and to expand the output of scientists and engineers — i.e. producing an adequate supply of highly qualified school teachers and university faculty ; extending the physical facilities for education ; meeting the operating costs of these facilities ; providing a much greater number of scholarships for students — will require a far larger total national outlay for education than heretofore. The question therefore arises : how will these activities be financed in future ?

Not only the elementary and secondary school systems but the teaching function of the colleges and universities are financed almost entirely from non-federal funds. Nearly four-fifths of the total national cost of higher education is met by (a) state and local governments (42 per cent) and (b) the income from student tuition and other fees (36 per cent). Most of the remainder is paid for by income from endowments, gifts and other private funds[1]. Although there is substantial spill-over from federal research support into teaching, the examiners estimated that in 1957-58 the direct contribution of the federal government to the teaching of students amounted to only 4 per cent of the total cost. The examiners questioned whether this distribution of effort can, or should, be maintained. They expressed the opinion (later echoed by a number of delegates) that the need for a substantial and immediate increase in the federal share of direct support for teaching is inescapable if the need for higher education (as measured by annual expenditure) increases from the present $4 billion (or 0.8 per cent of the Gross National Product) a year to $ 10 billion (1.4 per cent of GNP) by 1970 and if real equality of educational opportunity is to be achieved.

The American delegates did not deny the need for greatly increased federal support for education but stressed the political difficulties of bringing this about. Mr. Nestingen pointed out that the national obsession with education is not accompanied by a comparable national demand for federal action ; it expresses itself in the very strong but very general concern of most parents that educational opportunities should be available for their children. The growth of this feeling has, over the years, produced a system that already provides virtually universal secondary education and now includes a vast array of state universities many of which have become institutions not only of very large size but of very high quality. This parental concern does not, however, override two other fundamental beliefs that

1. See Examiners' Report, para. 48 *et seq*.

spring from the historical origin of the federal republic and are now deeply ingrained in its political philosophy.

The first of these is the doctrine of the separation of church and state which has its roots in the aspirations that drove many of the early colonists to brave the forbidding expanse of the Atlantic. As only one-third of the institutions for higher education are state institutions[1], any national programme in support of higher education must obviously include the privately controlled institutions. Many of the latter, however, are affiliated with various churches and the question of state support for church institutions immediately arises. Quite apart from the somewhat ambiguous question of constitutionality[2], this is a thorny political issue with strong emotional overtones.

The second is the doctrine of States' rights which rests on the explicit constitutional provision that powers not specifically delegated to the federal government are reserved to the states. Although the evolution of American government has been steadily in the direction of federalization, responsibility for education has remained firmly at the state and local (municipal and county) level. The U.S. Office of Education is not comparable, in any executive sense, to the ministries of education of other countries. Its traditional function is to gather and disseminate information and to offer assistance and advice. It also administers various federal assistance programmes. But the Office of Education exercises no control whatever over teachers or curricula ; it makes no policy and enforces no national regulations governing the physical or academic standards of schools. Proposals for extending fairly large-scale federal aid to schools and for making teaching grants to higher education institutions arouse the fear that such assistance will lead — directly or indirectly — to federal control. Like the religious issue, this is a point in which emotions are deeply involved.

As educational needs become more apparent to the general public, sentiment grows for increased federal aid — not in place of state support but in addition to similarly increased state appropriations. However, it is a moot question whether those who favour federal aid for elementary and secondary education are yet in the majority. This is an area of education in which the average citizen can, and does, exert his influence and exercise his responsibilities — through participation in board of education elections, attendance at local budget hearings, active membership in Parent-Teacher Associations, etc. The fear that the federal government — powerful and distant and thus less amenable to local pressures — might attempt to

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1. However, as the average size of publicly controlled institutions is larger than that of the privately controlled ones, 60% of the degree-credit students are now in publicly controlled colleges and universities.

2. The Constitutional provision that "Congress shall make no law respecting an establishment of religion, or prohibiting the free exercise thereof" has through tradition and judicial interpretation become the legal basis for the principle of separation of church and state. While the principle is accepted virtually without dissent in the United States, there has never been a clear demarcation of the line of separation. In practice, government recognizes and assists the part that religion plays in national life : churches are, for example, exempt from property taxes ; contributions to religious organizations are deductable on personal income-tax returns, and the coins with which even an agnostic pays his taxes are stamped "In God we trust". Furthermore, church-affiliated institutions have shared, without discrimination, in federal grants for research and for research facilities and hospital construction ; in the distribution of surplus federal property ; and in eligibility for loans under various national programmes.

exercise some control evokes strong personal feelings. General federal aid to local schools would, moreover, be a new departure from the traditional pattern of school financing. At present the federal government contributes about 350 million a year to the cost of operating and constructing elementary and secondary schools in areas affected by a heavy concentration of federal personnel (mostly military) ; since 1917 it has been making grants to states to stimulate vocational education which in 1962 amounted to $51 million a year or about 18 per cent of public funds spent for this purpose (the States appropriate about $104 million and local authorities about $128 million) ; it provides some limited assistance for the education of the physically handicapped and mentally retarded ; and, through the National Defense Education Act, it provides assistance for the improvement of teaching in science, mathematics, and modern foreign languages. But such special programmes are usually regarded as valid precedents for more general federal aid to elementary and secondary education.

The religious issue is also most sharply drawn in the national debate over federal aid to elementary and secondary education. As nearly six million school-age children (about 14 per cent) are in non-public schools the question of extending federal aid also to these schools is an important part of the general question of aid for elementary and secondary education. However, 90 per cent of these children (5.3 million) are in Roman Catholic parochial schools — in fact, one child out of every eight in the 6-18 age group is in a Catholic elementary or secondary school. To provide assistance from public funds to so large a church-controlled school system must have both a clear legal basis and the consent of a comfortable majority of people. At present, the legal basis has not been established beyond doubt and the majority does not yet consent.

On the other hand, there is little doubt that a majority of Americans now favour federal aid for higher education. Since the beginning of World War II the federal government has become increasingly — and very amicably — involved with the universities in the support of research, research-training and the construction of research facilities. Federal aid in support of university teaching functions would thus tend to be regarded as a further extension of a relationship which has, on the whole, worked very well for two decades.

In any case, federal aid for higher education is not new. A century ago the Congress, responding to public pressure, passed the Land Grant Act of 1862 under which federally owned public land was given to each state (roughly in proportion to population) with the stipulation that the proceeds from the sale of this land should be used to create and support agricultural and mechanical colleges[1]. This legislation was a most important step in the development of higher education in the United States since it laid the foundation for most of the present state universities. Since 1890, the federal government has also been making annual grants of money to these so-called land-grant colleges ; in 1962 this amounted to $14 million.

Acceptance of the principle of federal aid to higher education was further established and extended in fields related to scientific research by the fellowship and training programmes of the National Science Founda-

1. The land granted to the States totalled more than 11.4 million acres (4.6 million hectares), an area slightly larger than that of Denmark.

tion, the National Institutes of Health and a number of other federal agencies. The National Defense Education Act of 1958 similarly broadened the scope of federal aid by enlarging the fields of study covered, by adding a substantial student-loan programme to the means by which the federal government extends its aid, and by making special provisions for increasing the supply of teachers. An important feature of the loan programme is that up to half of the loan is forgiven at the rate of 10 per cent for each year in which the borrower is a full-time teacher in a public elementary or secondary school.

The National Defense Education Act is especially concerned with science, mathematics and foreign languages. The student-loan programme — which provides up to 90 per cent of the capital for student-loan funds operated by colleges and universities — is not, however, limited to these fields. During its first four years, loans totalling more than $230 million were made to 350,000 students in 1,450 institutions. It is estimated that loans will be made to 220,000 students during 1963 but this will not satisfy the demand.

The President's comprehensive educational support programme, submitted to Congress in the form of a proposed National Education Improvement Act, would increase the federal funds available for the student loan programme by 50 per cent — that is from $90 million to $135 million a year — and raise the amount a student may borrow during the course of his college years from $5,000 to $10,000. It would also extend the forgiveness feature to teachers in private schools.

Altogether, aid to education through the various federal programmes, now totalling something like $4 billion a year[1], would be increased during the next two or three years to $6 billion.

Even if the federal contribution increases to $10 billion by 1970, this alone will not provide the facilities, faculties, operating funds and student support required by the expanding population and increased demand for further education. The bulk of the money needed will have to continue to come from state and local governments. The real question that must be settled in the United States, therefore, is not whether the federal funds should replace state and local funds for education but simply whether the federal government should, in the interest of the nation as a whole, play a more effective part in meeting urgent educational needs.

Dr. Halsey drew attention to the wide variation in the accessibility and quality of education among the various states resulting from the wide disparity in the financial resources available to them. He suggested that federal aid to education might be used to redress these inequalities. M. Poignant (France) also asked how the federal government will try to adjust the burden of developing higher education to the financial resources of the poorer states.

Mr. Nestingen replied that this is not the real aim of the Administration. The purpose of its plans is to meet the national need for more, larger and better educational facilities. The effect of the various programmes — such as loans for modernization and new construction and the provision of capital for student-loan funds — will be to lessen the great disparity

1. Of this $4 billion only about $750-890 million is administered by the Office of Education.

that now exists in the financial resources available to institutions of higher learning. Concentration of federal aid on the areas of greatest need will naturally favour those institutions that have had the least financial assistance in the past and this, in turn, will favour the poorer states. But federal aid to higher education will be based on the needs of the individual institutions and not on the per capita wealth of the states. The proposed programmes are not intended to equalize state resources though they will, to some extent, have this indirect effect. On the other hand, the Administration believes that federal aid for elementary and secondary education *should* be allocated to the several states on the basis of population and per capita income — as is done in a number of other federal state-aid programmes. Here the purpose clearly should be to equalize the opportunities for and quality of basic and college-preparatory education.

Financing is not, of course, the sole solution for all educational problems — reorganization of the educational system can also play an important part. The examiners noted in their report that they were much impressed by the California Master Plan[1] and by the arguments for planning higher education on a state-wide basis. Under this plan all California high-school graduates will have access to tuition-free higher education in a three-tiered system : two year junior (or community) colleges which will admit any high-school graduate ; state colleges which will restrict entry to those in the upper third of their class ; and the state-supported University of California which will admit only those in the upper eighth. There will, however, be arrangements for transferring from the junior colleges to the state colleges or the university for the last two years of degree work.

In reply to Sir John Cockcroft's question about the extent to which the federal government can stimulate or initiate such state-wide planning, Mr. Nestingen said that the momentum for developments of this kind must be generated at state level with the co-operation of local communities. Under the American system this cannot be done by the federal government, which is not in a position to initiate state planning. It is, however, a proper function of the Office of Education to encourage planning, to disseminate information and to help in the development of state plans. More can undoubtedly be done in this direction than has yet been attempted.

Two-year community colleges are in process of becoming an integral part of the American system of higher education. Enrolment in these institutions now totals half a million, having doubled during the past ten years. In California and Florida nearly three-quarters of the students in their first two years of college are in junior or community colleges. The legislative proposals of the Administration envisage the construction of 25-30 new junior colleges each year during the next ten years. To this end the draft of the National Education Improvement Act contains a provision for $50 million a year in grants to states to be allocated on the basis of per capita income and the relative number of high-school graduates.

Mr. Nestingen expressed his personal view that a general development along the lines of the California plan would be in the best interest of every state and of the country as a whole. However, in many states both the initiative and the means are lacking. It was possible to develop such a plan in California because the state has excellent and agressive leader-

1. See Examiners' Report ; para 41.

ship in the field of education, and it will be possible to carry it out because the state is now the most populous and wealthiest. It is encouraging that the plan has attracted a great deal of attention particularly on the part of other state governments eleven of whom are, in fact, now contemplating similar action.

Quite apart from the variations in the quality of education offered in different states and by different institutions, there is inequality of educational opportunity resulting from the difference in the economic status of potential students. Although the United States has embarked on a programme of universal higher education, it has not yet removed the financial barrier that was removed from secondary education years ago. The examiners felt that the achievement of equality in higher eduction requires the allocation of public funds by the federal government to ensure that able students have the necessary scholarship support. Dr. Halsey noted, in this connection, that the Administration's legislative proposals for extending the scope of federal aid to education envisaged an expanded student loan programme but made no mention of scholarships.

The American delegation acknowledged that a financial barrier to higher education exists. In fact, Mr. Nestingen observed that the cost of education in the United States is rising more rapidly than family income and that it is difficult for some of the poorer students to attend college. This is particularly true of the upper levels of professional education as illustrated by the fact that 45 per cent of the graduates of medical and dental schools come from families in the upper 10 per cent of the income range.

There was, however, some disagreement among the delegates about the need for a large-scale federal scholarship programme. Mr. Nestingen expressed a preference for loans on the ground that a loan gives the student a greater feeling of responsibility. Since repayment can be made over a long period in fairly small instalments, he felt that a loan imposes no undue hardship and adequately serves the purpose of enabling the student to go to college. Dr. Beadle, on the other hand, argued that loans, in some ways, accentuate inequality of opportunity. As all major universities and colleges have scholarships and fellowships which are awarded primarily on the basis of ability, the best students get outright scholarships while less outstanding students, who probably have a lower income potential, have to depend on loans. Moreover, the major private universities, which have the larger scholarship funds, are able to compete most successfully for scholarship students thus making it more difficult for needy students who have to depend on loans to gain admission to these institutions.

The question of responsibility for repayment was raised by Prof. Elvin (United Kingdom). In reply it was pointed out that, while the parents are legally responsible for loans made to students under 21 years of age, the collection of repayments has presented no serious problem. Dr. Hill cited the example of the large and long-standing loan programme of the Massachusetts Institute of Technology whose beneficiaries have an almost perfect repayment record. The much more recent federal loan programme (under the National Defense Education Act) has also encountered no difficulties. The moral obligation felt by students who have been helped by loans is sufficiently strong for recourse to their, or their parents', legal obligation almost never to be necessary.

Sir John Cockroft enquired whether the lack of financial assistance is responsible for the high drop-out rate in both undergraduate and graduate courses in the United States and whether it was true that the necessity for some students to earn a large part of their support dragged out their educational programme by an average of two years.

Dr. Tyler replied that this was not a problem at the graduate level in science and technology. At most of the better known universities some 80 per cent of the graduate students in these fields have fellowships or teaching assistantships and the drop-out rate is, in fact, quite low. But the drop-out rate among undergraduates, in the sciences no less than in other fields, is very high. Among state universities — where both tuition fees and entrance standards are lower than at the major private universities — as many as 40 per cent of the first-year students do not survive to graduation. At the undergraduate level lack of money is clearly a major factor and there is a need for more federal participation in the support of undergraduate education. The problem is to make this politically palatable.

There are, of course, many other reasons for a student dropping out of college. Change in motivation is an important factor especially among young women many of whom are married during their college years and lose the incentive to complete their college courses. This represents a significant wastage of talent now that more than half of the women college graduates over 40 — having completed their families — are returning to the labour force. Rebellion against long years of schooling, against dependence on parents, and against parental control is also common among middle-class youngsters causing them to drop out of college, often in their junior year. Sometimes this restlessness merely causes them to transfer to another college — in one example cited by Dr. Tyler 10 per cent of the so-called drop-outs had in fact gone to another college. Finally, the reason may be lack of academic success, though this is often a symptom of other underlying factors rather than the result of a simple lack of ability.

The wastage caused by drop-outs is a matter of considerable concern in the U.S. A number of studies are underway to unravel the complex causes and to devise ways of combating them. If the drop-out rate could be substantially reduced, the stock of qualified manpower would be significantly increased.

5. THE EFFECT OF FEDERAL SUPPORT FOR SCIENCE ON HIGHER EDUCATION

The present involvement of the federal government with the colleges and universities is largely due to the proper concern of any modern government with ensuring a maximum rate of economic growth, fostering social welfare (especially the health of its citizens), providing adequate national defence and, as Dr. Halsey phrased it, 'keeping up the national prestige of its culture'. As the means for doing each of these things have become more and more dependent on scientific and technological advances, there has been a very rapid ascendency of science in the cultural pattern of society. This alone has had an important influence on the balance of intellectual life in the universities which had had to adapt to this changing cultural pattern their traditional role of preserving and handing on to each new generation the knowledge, skills and ethos of the society of which they are a part.

The impact on the universities of the government's concerns has, however, been greatly heightened by the fact that the government's effort to advance a scientific culture mainly takes the form of stimulating and supporting the research process that is centred in the universities. In the United States, the federal government's financial support for research in colleges and universities grew from $150 million in 1952 to nearly $700 million in 1962. As a result of this almost five-fold increase in a decade, at least three-quarters of all separately budgeted research and development in colleges and universities is now federally financed.

The relatively rapid influx of funds earmarked for scientific research has changed the pattern of activity in institutions of higher education. It raises the question of whether research is being strengthened at the expense of teaching, whether large universities with strong science departments are being further strengthened at the expense of teaching, whether large universities with strong science departments are being further strengthened at the expense of the smaller universities and liberal arts colleges, and finally, whether scientific effort generally is being strengthened at the expense of the humanities.

As the government is immediately concerned with research rather than teaching — or with science rather than scientists — there is a strong tendency for the more talented people to be drawn away from the lower levels of teaching. In the United States, to a more marked degree than in other countries, prestige, career opportunities and material rewards tend to go not to those who devote themselves to the important work of teaching undergraduates but to those doing research in graduate schools. Dr. Halsey and the Chairman (Mr. Friis, Denmark) therefore asked whether American universities were not gradually sliding so much to the research side that

the teaching side was being seriously weakened. The problem of deciding to what extent money should be put into research and to what extent it should be put in education, in its more restricted sense, exists in many countries but seems to be particularly urgent in the United States.

The American delegation agreed that teaching must compete with research for the top people, and Dr. Hill voiced the suspicion that this competition was affecting both the quantity and quality of the output of baccalaureate science degrees. The desire among teachers to spend time on research is due not only to the availability of research support but to the fact that the publication of research papers so often seems to be a prerequisite for academic advancement. Young men doing graduate work in an atmosphere in which research is accorded so much prestige are not likely to be inspired to select teaching as their primary vocation. The situation is thus not only perpetuated but gradually becomes worse.

On the other hand, research support also makes a substantial contribution to education, especially at the graduate level. Most research grants make provision for research assistantships which are an important source of support for graduate students. A number of federal agencies — notably the National Science Foundation and the National Institutes of Health — make research-training grants of various kinds which include funds not only for student stipends but for faculty salaries and equipment. Direct support for university teaching, as a complementary part of research-oriented federal programmes, is rapidly growing. Of the proposed increase of $262.9 million in the National Science Foundation's budget for the fiscal year 1964, one-fourth is for activities directly related to the instruction of students. Similarly, of the $930 million requested for the National Institutes of Health, $218 million (23 per cent) is for training in the biological and medical sciences.

Moreover, the indirect value of research activities to the teaching process at both the graduate and undergraduate level must not be overlooked. In some cases equipment provided by research grants is also used by undergraduate students. Almost always the presence of a vigorous research programme has a stimulating effect on the undergraduate students at the institution. At the graduate level research and teaching are regarded as fully complementary and inseparable. Few American scientists would agree with the research workers quoted by M. Capelle (France) who feel that research work is incompatible with teaching and that pedagogical training for teaching has a stultifying effect on aptitudes for research. Sir John Cockcroft commented that this was also contrary to his own experience ; he had found that the obligation to do some teaching was rather a good thing and he hoped that the United States would find ways of ensuring that research people did their fair share of tuition.

In fact, a fairly common complaint among the scientific staff in some of the national laboratories exclusively devoted to research is that the absence of the self-discipline imposed by teaching — and of the respite from research that it provides — has a deleterious effect on research. It is partly for this reason that serious consideration is being given to ways in which the superb facilities and highly competent staff of these laboratories might be brought to play a part in graduate and post-doctoral education. Dr. Beadle pointed out that the National Aeronautics and Space Agency had decided to establish its research centres in collaboration with the

universities so that these centres could be closely associated with the educational system. He predicted that there would be a general movement to make more effective educational use of national research facilities.

Sir Willis Jackson (United Kingdom) said that the scale on which research is supported in American universities had many beneficial effects ; academic research, for example, had become much more realistic and scientists had become more mobile. As other countries are considering the feasibility and desirability of similar patterns of research support, he thought it would be useful to know how sponsored research has affected university finance and to what extent it has had a detrimental effect on educational policy within the university system.

Dr. Beadle replied that grants and contracts from the federal government have certainly had a great effect on the system, and important consequences for the financing of higher education. Perhaps the most serious of these is that, in a free competitive system, increased support for mathematics, science and engineering tends to distort the salary structure. In order to keep competent people in the fields in which support is available it is necessary to raise salaries, or another institution will hire them away. The preferential position thus created then tempts people to shift from other fields into those where higher salaries exist. In some cases, the relatively high stipends available to graduate students in the sciences has even made it difficult to recruit graduate students in other fields. Such distortions already cause difficulties whether or not they are regarded as being *per se* undesirable.

On the other hand, many American institutions of higher learning could not exist in their present form without the financial support that federal grants and contracts provide. Almost 50 per cent of the income of the University of Chicago (excluding the Argonne Laboratory), for example, comes from these sources and this is bound to have a significant effect on the character of the university and of the flexibility of its academic programme. However, without this aid the university would be in a much weaker position. The trend has, in any case, been irresistible — if a major university refused research support it would inevitably drop to a second-rate position.

Research support could, of course, be refused. Dr. Tyler emphasised that the final decision about the volume of sponsored research at a university or college is made not by the federal government but by the trustees and administrative faculty of the institution. Both Dr. Tyler and Dr. Stoke pointed out that a university can, if it wishes, to some extent counter-balance the weight of federal support for research and for science and mathematics by shifting funds obtained from state or private sources to activities not enjoying federal support. However, the money which the federal government makes available for science is at present so much more than the amount the universities can shift that it is difficult to maintain a balance. There has inevitably been a great spurt in investment in facilities and faculty for the natural sciences.

Dr. Beadle commented that this investment was in part derived from the universities' general funds. He said that he had never seen a science or mathematics department reduce its claim on general university funds because it had received a federal grant or contract ; on the contrary, the more federal funds a university receives for research, the more general

funds have to be put into science facilities thus contributing further to the imbalance between science and other subjects. Some grants and contracts, moreover, provide for only partial reimbursement for the actual cost of administrative and other common services with the result that the university has to take money from other activities to cover part of the expense of the sponsored research.

Although the volume of federal research support has created problems for the universities and has some undesirable side-effets, it has, on the whole, been highly beneficial since both the country and the individual institutions have gained in strength and vitality. On this all members of the American delegation were firmly agreed.

Commenting on the survey, quoted in the Examiners' Report,[1] in which 70 per cent of the scientists questioned expressed the view that the present pattern of federal research support is neither in the *long run* national interest nor in the best interest of their institution, Mr. Nestingen said that he had no doubt that the general effect of federal expenditures on research and education in recent years has been very much in the national interest. Imbalances exist — especially in the lack of adequate support for teacher training — because the United States has for a long time provided far less federal aid to education than it should have done. The interest in encouraging the study of science that was generated in the mid-1950's — and was greatly heightened by the Sputnik launching in 1957 has resulted in programmes that give disproportionate emphasis to science and, within the science fields, to research rather than teaching. There is every reason to believe, however, that the pendulum will swing in the opposite direction in the year immediately ahead thus equalizing some of the imbalances that now exist. Dr. Dees added that there are large gaps in the federal government's support for education for much the same reason that the O.E.C.D. does not have a unit devoted to music: the federal agencies have done what seemed most urgent and what it was possible for them to do within the legislative and political framework in which they must operate. As needs change and as the framework is broadened, the programme will change and broaden.

The amount of federal money that goes to universities fo one thing or another is now hundreds of times greater than it was just before World War II. Immediately after World War II a great many people felt that the technique developed, largely by the wartime Office of Scientific Research and Development, for utilising university faculty and facilities to help in solving defence problems should be utilised in peacetime also for the general welfare of the nation. As a result, a variety of programmes got under way, not the least of which is the very large-scale research effort in the biological and medical sciences administrated by the National Institutes of Health. Basic research going well beyond the narrow limits of military requirements was also supported, on a contract basis, by the Office of Naval Research in the Department of Defense. Then, in 1950, the National Science Foundation was created with a broader mandate to support scientific research and education.

In the immediate post-war years, there was considerable hesitancy in the universities about accepting this new kind of largesse from the

1. Paras. 23-25.

federal government. University administrators were not at all sure that this money could be used wisely and well, and they were seriously worried about the imbalances it might create. However, after more than a decade of experience with the rapidly growing federal support programmes, all of the hesitancy about accepting and most of the worry about the effect of this assistance has disappeared. At a meeting of the American Council on Education in October 1962, the presidents and deans of institutions throughout the United States were clearly in agreement with the view of Mr. McGeorge Bundy, the former Dean of Harvard University, that "federal investment in the higher learning has been extraordinarily productive, both for the national security and for the quality of our civilisation", and that "the processes of this investment have on the whole been such as to enhance the freedom and independent strength of American colleges and universities".

This is not to say that there is no concern about the overall impact of federal support on American universities or that problems have ceased to exist. The Orlans report, cited by the examiners, and a recent report by a committee chaired by President Pusey of Harvard illustrate the problems of balance and warn that these problems may become more serious. But it is clear that these problems are manageable and do not constitute a basic indictment of the federal support mechanism. The relatively few unfortunate side-effects of the federal programme should not obscure its tremendous value to higher education.

Just as it became politically possible immediately after the war to get federal funds for research, it has in the past few years become possible to use the magic word "science" to get support for science education. In order to avoid the political difficulties standing in the way of general federal aid to education, support is being extended to broader segments of the educational system very gradually but the scale of support already achieved is by no means trivial. The proposed 1964 budget for the National Science Foundation alone includes some $160 million for educational programmes that have no direct connection with the support of research while another $100 million is sought for programmes that support education as well as research. Other agencies similarly have large educational components in their budgets.

In considering the impact of federal research funds on higher education in the United States, it should be borne in mind that most of the money has, in fact, gone to only about 50 of nearly 2,000 institutions[1]. There are close to 200 institutions that award doctoral degrees, another 400 or so which award Master's degrees, and about 800 that award nothing higher than Bachelor's degrees. With the exception of a very limited number of institutions that are strongly research-oriented, the funds received by these institutions from the federal government are far too small to create imbalances or to have debilitating effects on their academic programmes. In fact, most of these institutions, as Dr. Dees put it, are very much concerned because they do not get enough debilitation — they would

1. In 1960 there were 143 universities, 764 liberal arts colleges, 544 separately organised professional schools (teachers colleges, technical colleges, etc.) and 524 junior colleges. All told, 291 institutions received some federal research money in 1958 but most of them had very small amounts such as a single small grant to one member of the faculty. Half of these institutions collectively accounted for only 3% of the funds.

like very much to participate more extensively in the federal research programmes that now exist.

The uneven distribution of research funds has had the effect, as Dr. Tyler pointed out, of tipping the balance in some institutions from science toward the humanities. The absence of vigorous research in the natural sciences has made it possible for the liberal arts colleges (which do not have graduate departments and have therefore had few federal grants or contracts) to give more attention to the humanities. Their inability to compete with the research facilities and higher salaries available in the science department of the major universities has, however, also made it more difficult for them to get good science teachers. The problem of imbalance is therefore exactly the opposite — in the liberal arts college there is a need to restore a better balance by strengthening science. Dr. Rees added that this is the problem not only in the liberal arts colleges (which award only about a quarter of the bachelor's degrees) but in the undergraduate departments of most of the universities. Some of the good liberal arts colleges — an important and highly respected element of the American educational system — are doing a much better job at the undergraduate level than many of the major universities. The problem therefore is to find ways of strengthening undergraduate science education generally. The National Science Foundation is very much concerned about this problem and is now putting much more emphasis on developing those of its programmes that have an impact on undergraduate science education.

In other words, the effect of massive research support is as much a problem of balance between undergraduate and graduate teaching within science as of balance between science and the humanities. Nevertheless, plans for broader federal aid to education recognise that the humanities have been relatively neglected. The intention is to make better provision — in the context of general federal aid to education — for the humanities not only as a separate field of study but also as an element in the education of scientists and technologists.

Sir Willis Jackson (United Kingdom) remarked that there is not nowadays much argument about the need to liberalise the education of scientists and technologists by exposing them to humanistic studies. However, there is not a corresponding willingness to recognize that education in the humanities must be liberalised by closer contact with science and technology. He asked whether it was felt in the United States that the administrators and politicians of the future will need to know more about science than their predecessors have in the past and, if so, what was being done to provide this knowledge.

Dr. Tyler replied that it is widely agreed in the United States that a more intimate acquaintance with science is increasingly important not only for administrators and politicians but for the ordinary citizen — especially in his capacity of voter. The role of science as part of a general education was, in fact, recognised in 1950 when the National Science Foundation was created. Its legislative directive to foster and improve science teaching is aimed not solely at the production of scientists and engineers but also at broadening the liberal education of those whose specialisation will not be in science. The programmes of the National Science Foundation are devised with this general aim also in view.

Most of the liberal arts colleges and undergraduate schools of the

universities require some high school science for admission and many include at least one science course (usually involving laboratory work) in their requirements for an arts degree. Increasing attention is also paid to the need for some general science education for adults, and experiments with television programmes are in progress. The major emphasis at the present time, however, is on improving the availability and quality of science courses in the secondary schools through which virtually all American children must pass. In this field considerable progress is being made.

The whole question of the balance between science and the humanities, of the role of science in a liberal education, and of the need of non-scientists for an understanding of science can really be answered only in terms of the kind of society a country is trying to create. In this connection, Prof. Elvin (United Kingdom) mentioned the advice Benjamin Franklin gave young men who wanted to emigrate to the then new United States. Franklin said, in effect: If you are a hard worker or a good craftsman, come; if you want to be an artist or a poet, don't come now — later on there will be opportunities for artists and poets but at this stage we must open up a new country by hard work.

The criterion by which the impact of the federal science programmes must be judged is their relevance to future national needs — not their effect on the traditional patterns of higher education but their effectiveness in helping to create the new patterns demanded by an egalitarian technological society during the latter half of the 20th century. Dr. Stoke, in closing the discussion, stated his view of the effect of federal support for science on higher education in these words:

> "I have spent my life in higher education and I have come to appreciate its indispensability and also some of its weaknesses. Colleges and universities are no more free from occupational diseases than other institutions — left to itself any institution tends to be operated for the benefit of those who operate it, whether it is a government bureaucracy, the Church, a corporation or a university. This is a universal characteristic. Clemenceau said that war is too important to be left to the generals — after spending a lifetime in education I am prepared to say that education is too important to be left to the educators. The more education affects every aspect of national life, the more its limitations become so important to society that they cannot be left to the ineffective process of self-correction.
>
> "For years the American educational system sought to reform itself in respect of teacher training. It failed. It was not until we felt the impact of the intervention of the National Science Foundation that we succeeded to some extent. The National Defense Education Act has done more for the teaching of foreign languages in four years than we educators have been able to accomplish independently in twenty.
>
> "Intervention from outside the closed orbit of the universities has had a vitalising effect upon them which has a tremendous immediate and long-term value. Institutions require this kind of intervention for their own good and I think that this fact has recently been amply demonstrated.
>
> "If we permit ourselves to become preoccupied with the preservation of academic balance we shall no longer be making progress. The surest way of maintaining the *status quo* is to keep things in balance.

I am in favour of the imbalance that has been brought about by the support of science and I hope that it will continue for a little while. There is a real question, it seems to me, whether intellectual progress can ever be made evenly. It is only by throwing things out of balance that one stimulates activity as those on the short end of the see-saw try to restore the balance. This is the way to progress.

"I firmly believe that society's present emphasis on science has done more to create an intellectual renaissance, not only in science but in all fields of endeavour, than any other intervention during the past quarter of a century."

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